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INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification 5 : H01L 21/00	A1	(11) International Publication Number: WO 91/12629 (43) International Publication Date: 22 August 1991 (22.08.91)

(21) International Application Number: PCT/NL91/00025

(22) International Filing Date: 15 February 1991 (15.02.91)

(30) Priority data:

9000374	16 February 1990 (16.02.90)	NL
9000376	16 February 1990 (16.02.90)	NL
9000579	14 March 1990 (14.03.90)	NL
9000903	17 April 1990 (17.04.90)	NL
9001177	21 May 1990 (21.05.90)	NL
9001400	20 June 1990 (20.06.90)	NL
9001862	23 August 1990 (23.08.90)	NL
9100237	11 February 1991 (11.02.91)	NL

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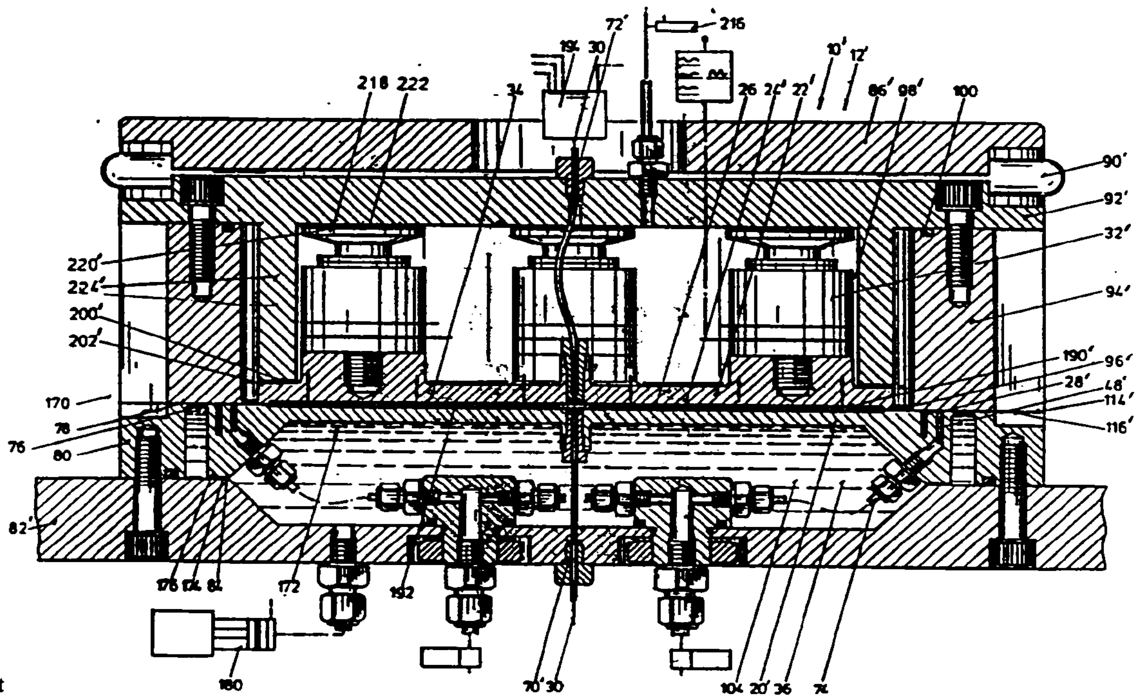
(81) Designated States: AT (European patent), BE (European patent), CH (European patent), DE (European patent), DK (European patent), ES (European patent), FR (European patent), GB (European patent), GR (European patent), IT (European patent), JP, KR, LU (European patent), NL (European patent), SE (European patent), SU, US.

Published
With international search report.
In English translation (filed in Dutch).

(54) Title: IMPROVED INSTALLATION FOR WAFER TRANSFER AND PROCESSING



(57) Abstract

Installation (10) for transfer and processing of wafers (26), whereby for an at least contamination-free wafer transfer in cleaning module (12) an all-sided wafer cleaning takes place within an inert gas environment, within an at least temporary established medium discharge gap, located in between chamber blocks (20 and 22), and extending in laterally outward direction from cleaning chamber (24) toward discharge passage (28), at least jointly by means of said inert gas a sealing-off system is accomplished for a controlled discharge of the cleaning medium from said cleaning chamber.

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Improved installation for wafer transfer and processing.

BACKGROUND OF THE INVENTION:

1. Field of the invention:

The invention relates to apparatus and methods, wherein the following takes place:

a) an all-sided wafer cleaning under a pulsating double-floating condition in an inert gas environment;

b) minimizing the deposition of contaminants on the cleaned wafer during is transfer from the cleaning chamber toward a wafer processing module or other equipment; and

c) minimizing the inclusion of sub-micron contaminants in such cleaned wafer.

2. Description of the prior art:

Advanced all-sided wafer cleaning, taking place within a mini cleaning chamber without any mechanically displacing component in this chamber provides an improved wafer cleaning condition.

Such all-sided wafer cleaning, together with the required apparatus, are described in the PCT Patent Application, Serial Nr. PCT/NL89/00092 of the applicants.

Thereby this wafer cleaning is one of the wafer processings, that possibly might take place in such apparatus.

This apparatus has the following shortcomings:

a) During the wafer cleaning in the cleaning chamber the wafer cleaning system, including the cylindrical discharge passage and gaseous lock compartment,are at least temporary sealed off from the outer air.

During the urging of both chamber blocks against each other mainly at the outer sealing-off sections, located in lateral direction outward this gaseous lock compartment, sub-micron contaminants can be created, also with the application of teflon PFA and PTFE linings for these blocks.

After the wafer cleaning these sealing-off sections for the greater part function as wafer transfer wall sections of these blocks on both sides of the established wafer transfer passage in between these blocks.

At least locally the contaminants cannot be removed sufficiently by means of gaseous medium, after the cleaning moving from the gaseous lock compartment along these wall sections.

The future sub-micron wafer processing, consisting of at least 500 processing steps,with mostly a pre- and/or post cleaning of the wafer to be processed, does not allow such deposition of contaminants on the wafer.

Consequently, such repeated deposition of sub micron contaminants on the wafer has to be avoided as much as possible to contribute to a highest possible wafer yield.

b) For discharge of the cleaning medium from this chamber the required creation of a cylindrical discharge gap in between this chamber and this discharge passage and in between the gaseous lock compartment and this discharge passage has to take place.

Because often the discharge of medium is restricted, in particular with wafer cleaning under vacuum, only approximately 100 mm^3 per second for an 8" wafer and less than 3 cm^3 per discharge cycle, the average height of such gaps is minimal, for instance only 3 µm, with possibly large deviations therein due to machining tolerances for the cooperating components and local differences in temperature and pressure.

Thereby possibly locally a not being opened of these discharge gaps, with in that section, due to no medium discharge, a negative influence on the wafer cleaning.

Consequently, in these apparatus stop walls are used, against which the central section of such chamber block is urged during the wafer cleaning, with the creation of micro cylindrical discharge gaps in between the cleaning chamber and the discharge passage and in between this passage and the gaseous lock compartment.

This however makes the apparatus more complicated, in particular, if therein whether or not in addition a cleaning under vacuum has to take place.

SUMMARY OF THE INVENTION:

It is an object of the invention to provide an apparatus and methods, which eliminates these shortcomings and whereby this apparatus mainly is characterized by the following:

a) For both chamber blocks the application of at least a combination of cooperating stop wall sections and at least almost contact-free wall sections;

b) With stop wall sections, urged against each other, at least the wall sections of these chamber blocks, which are located in between this cleaning chamber and the cylindrical discharge passage and in between this discharge passage and the gaseous lock compartment are removed from each other over such micro distance, that in between cylindrical micro discharge gaps are established, which are interrupted whether or not locally;

c) The wall sections, located in lateral direction outward this gaseous

lock compartment, are removed from each other over maximal a micro distance;

d) Thereby these wall sections at least at the wafer transfer area thereof for the wafer, cleaned in the cleaning chamber, are removed from each other over maximal a micro distance and for the rest thereof are stop- and sealing-off wall sections.

By means of high-precision machining of these blocks the heights of each of such gaps in radial direction are almost the same.

Here also, the application of a pulsator chamber, wherein one or more pulsators are located, with therein a thrust medium, providing a contra thrust for the pressure of the cleaning medium in the cleaning chamber.

By means of possibly an extremely small height of the discharge gap in between the cleaning chamber and the discharge passage, for instance 5 µm, with eventually a considerable length of this gap, during the wafer cleaning, with a pressure in this discharge passage, that approximately is the same as the average pressure of the cleaning medium in this chamber, by means of the buffer functioning of this discharge gap at least almost no discharge of cleaning medium takes place from this chamber.

Thereby such medium as finished-off medium is easily replaced by fresh cleaning medium, centrally supplied into this chamber.

Furthermore, with a pressure in this discharge passage, which is considerably lower than the average pressure of the cleaning medium in the clening chamber and considerably lower than the pressure in the pulsator chamber, a temporary sealing-off of the discharge gap takes place by means of urging a sealing-off section of the membrane section against a corresponding sealing-off section of the other chamber block.

Due to the considerable flow resistance within the cylindrical gap in between the gaseous lock compartment and this discharge passage and possibly in combination with only a limited overpressure of the gaseous medium in this compartment with regard to the pressure in this discharge passage, the discharge of this medium from this compartment through this gap toward this passage is negligible.

Furthermore, due to possibly a great length of the ultra narrow gap in between both chamber blocks in lateral direction outward the gaseous lock compartment, in combination with maximal a micro height thereof and the eventually profiled walls of this gap, the consumption of gaseous medium is almost nil.

If however, in this discharge passage the overpressure is reduced for the discharge of finished-off cleaning medium from the cleaning chamber,

then both an increased discharge of such finished-off cleaning medium from this chamber and an increased urging of gaseous rinse medium from the gaseous lock compartment take place.

Hereby in this discharge passage the discharge of this mixture takes place in downward direction.

In this way,a first aggressive cleaning medium is urged from the cleaning chamber by a following flow of less aggressive medium, as for instance de-ionized water, and whether or not in between by a flow of gaseous medium.

At the end of the wafer cleaning a removal of the last cleaning medium from this chamber takes place by means of centrally supplied rinse medium and whereby even temporary a negative pressure can be maintained in this discharge passage.

During this cleaning action by means of a thrust block arrangement these chamber blocks at these stop walls remain urged against each other.

If temporary such thrust is ended, as by means of a discharge of medium from such thrust block assembly, then an urging from each other of these blocks take place, as for the subsequent transfer of the cleaned wafer.

Due to this extremely narrow gap outwardly the gaseous lock compartment, it is also possible, that in this cleaning chamber wafer cleaning takes place under a negative pressure or even a vacuum.

As a result, this cleaning module in particular is suitable for an at least combined cleaning of the wafer under atmosoheric and negative pressure, whereby gaseous and vaporized medium is used in whether or not a combination thereof.

Furthermore, this module is suitable for at least temporary de-hydration bake, with the removal of moisture from this wafer.

Because of the considerable flow resistance for the expelled medium, a local medium discharge in a gap section results in a considerable drop in pressure therein. Thereby such considerable flow resistance is also accomplished by the micro flows of the up and downwardly pulsating medium, causing a hefty whirling action of the medium in this micro gap.

The medium in the pulsator chamber exercises a sealing-off thrust on the pulsating central chamber block section and membrane section, through which in case of such pressure drop immediately a narrowing of this gap section is accomplished, in particular at this membrane section, with the restoring of the thrust balance at this gap section and an at least reduced discharge of the medium.

By means of this continuous correcting action for all gap sections, such uniform mini medium discharge is now quaranteed.

With no medium supply toward the cleaning chamber this height height of the discharge gap stabilizes on such minimal level, that this membrane as sealing-off element to such extent seales off this cleaning chamber, that thereby during some seconds the wafer cleaning under pulsating double-floating condition can be continued.

Thereby temporary the urging of the membrane sealing-off section against the corresponding section of the other block .

Due to the extremely small reciprocating displacements of this sealing-off section to open and seal off the discharge in combination with the flexible configuration of the membrane,it is hardly possible, that the central chamberblock section by means of displacing this membrane section can accomplish such micro displacements.

Now, a following favorable feature is, that the opening and sealing-off of the discharge gap at the membrane sealing off section mainly takes place by means of established differences in pressure of the mediums, acting on both sides of this membrane section.

Furthermore, in this module the possible application of any pressure in the cleaning chamber, wanted, as for wafer cleaning by means of super critical fluids, as CO_2, whereby frequently the liquid phase is changed into gaseous phase and in return.

Furthermore, the application of rapid successions in pressure differences, with even the transfer of cleaning under overpressure into cleaning under negative pressure.

Thereby the possible application of an almost constant pressure and possibly even a negative pressure in the discharge passage, if wanted.

Thereby in a following favorable configuration the membrane sealing-off section is located nearby the membrane side, nearest to the discharge passage.

In that case, the level of the pressure in the discharge gap at the cleaning chamber side has become almost independent from the level of the pressure in the discharge gap at the dischargepassage side of this sealing-off section.

Furthermore, the module is provided with a stop/buffer system for the pulsating central chamberblock section for limiting the maximum height of the cleaning chamber.

Thereby in this pulsator chamber a stop wall is located, against which the central chamber block section with a corresponding stop section is urged, with in between a medium layer, the thickness of which depends on the thrust of the cleaning medium in the cleaning chamber,applied thereon.

In that way during the wafer cleaning the pressure in the cleaning chamber is at least temporary independent from the pressure in the pulsator chamber and also from the pressure in the discharge passage.

As a result, now an effective use can be made of a compartment, containing an inert gas , whereby highly filtered inert gas from this compartment is supplied toward this discharge passage to establish a gaseous lock and provide rinse medium.

For the sub-micon wafer processing in particular with the wafer processing under high vacuum the enclosed moisture within the wafer causes contaminants, because this moisture during such wafer processing escapes through the wafer processing side or remains enclosed, with the creation of unallowable deformations in the sub-micron line configuration.

In addition, the air contains sub-micron contaminants, which cannot be removed adequately by means of filters.

Furthermore, during the maintenance of the wafer transfer/processing/diagnostic modules the transfer of contaminants from the maintenance personnel toward these modules cannot be avoided.

Such inert gas environment now offers the possibility to abolish these shortcomings.

Thereby such maintenance takes place by personnel, which is located within a contamination-free enclosure with an own respiration medium.

By means of a single person elevator the enclosure is accessible from a compartment underneath, containing air.

In this inert gas compartment a number of wafer cleaning modules cooperate with a series of wafer processing- and other modules and whereby also the wafer transfer and the maintenance to a high extent is contamination-free.

In that way,the possibility of an effective sub-micron wafer processing, resulting in a high wafer yield.

The module also contains a buffer for damping the vibrations of such pulsator at the stationary side thereof and whereby use is made of the thrust medium within the pulsator chamber as medium buffer in between the pulsator wall and a contra wall.

The above-discussed and many other features and attendant advantages of the present invention will become better understood by reference to the following detailed description when considered in conjunction with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

In the accompanying drawings:

Figure 1 is a longitudinal sectional view of a cleaning module of the apparatus according to the invention.

Figure 2 is a sectional view over the line 2-2 of the module according to Figure 1.

Figure 3 is a sectional view over the line 3-3 of the module according to Figure 1.

Figure 4 is a longitudinal sectional view of a modification of the module according to Figure 1.

Figure 5 is still another module, whereby the pulsating reciprocation of the central upper chamber block section is established by means of supply and discharge of liquid medium toward and from an upper compartment as pulsator chamber.

Figure 6 is a module, wherein also the central lower chamber block is pulsating.

Figure 6^A discloses for the module according to Figure 6 the medium discharge toward the discharge passage and the medium supply toward the gaseous lock compartment.

Figure 6^B discloses for the module according to Figure 6 cooperating vibrations of both central sections of the chamber blocks.

Figure 7 shows enlarged part of the wafer cleaning and medium discharge section of the module according to Figure 1.

Figure 7^A shows a pressure diagram for the section according to Figure 7.

Figure 7^B shows an enlarged part of the section according to Figure 7 at the membrane section.

Figure 7^C shows in part a sectional view of the walls of the medium discharge gap, on which a teflon lining is anchored.

Figure 8^A shows at the membrane section the discharge of cleaning medium during the upward displacement of the central upper chamber block section.

Figure 8^B shows for the section according to Figure 8^A the sealed-off discharge gap during the compression stroke in downward direction.

Figure 8^C shows the upper chamber block, with at the central section of the membrane a mini lowered cylindrical section for sealing-off.

Figures 9^A through 9^C show for a modified medium discharge section the arrangement of two membrane sections, with in between a sealing-off wall, and with several positions of this section during the module operation.

Figures 10^A and 10^B show enlarged part of the sectional view according to Figure 7, with the membrane section in an open and sealed-off position.

Figures 10^C and 10^D show enlarged part of the sectional view according to Figure 7 near the cleaning chamber in open and almost sealed-off position.

Figures 11^A through 11^D show enlarged successive medium charge positions and the subsequent wafer cleaning position of the central upper chamber block section.

Figure 12^A and Figure 12^B in an enlarged view show the medium discharge section of the module according to Figure 4, with a temporary sealing-off of the cleaning chamber.

Figure 12^C and Figure 12^D in an enlarged view show the section according to Figure 12^A with a medium discharge from the cleaning chamber.

Figure 13^A shows for the module according to Figure 1 the medium charge of the sealed off cleaning chamber by means of a reciprocating stop wall arrangement of the central upper chamber block section as volume limiter.

Figure 13^B shows enlarged the medium charge system according to Figure 13^A.

Figure 14^A shows for the module section according to Figure 13^A by means of the volume limitation of the cleaning chamber with the reciprocating stop wall of the central upper chamber block section the creation of a difference in pressure between the cleaning chamber and the pulsator chamber to establish the medium discharge.

Figure 14^B shows enlarged the sealing-off system according to Figure 14^A.

Figure 15 shows enlarged the buffer and stop sections of the pulsating central block section of the module according to Figure 1.

Figure 16^A shows enlarged the section according to Figure 15 in its wafer cleaning position.

Figure 16^B shows in this wafer cleaning position on an enlarged scale the small vibration amplitude of the sections on top of the pulsators with regard to the vibration amplitude of the chamber upperwall, as shown in Figure 16^C.

Figure 17^A shows enlarged the system according to Figure 13, whereby by means of the stop wall arrangement for the central upper chamber block section a medium charge under high pressure takes place for the cleaning chamber.

Figure 17^B shows enlarged the system according to Figure 13, whereby by means of the stop wall arrangement a considerable reduction of the pressure in the cleaning chamber is established.

Figure 17^C shows the system according to Figure 17^B, with a pressure drop from overpressure toward a negative pressure.

Figures 18^A through 18^E show for the module according to Figure 1 succes-

sive transfer positions for a wafer, to be cleaned.

Figures 19^A through 19^C show for the module according to Figure 1 modified wafer transfer positions for a wafer, to be cleaned.

Figure 20 shows the centering of the wafer toward within a recess of the vibrating upper chamber wall by means of a scissor movement of this wall.

Figure 21 is an enlarged part of the module-section according to Figure 20 at this scissor movement.

Figure 22 is a sectional view over the line 22-22 of the section according to Figure 21.

Figures 23^A through 23^D show the take-over system of the cleaned wafer by means of a robot arm from its suctioned position against the upper chamber wall.

Figures 24 through 26 show enlarged wafer cleaning under overpressure for the module according to Figure 1.

Figures 27 and 28 show enlarged wafer cleaning under vacuum for the module according to Figure 1.

Figure 29 is a longitudinal sectional viw of the apparatus according to the invention, wherein within an isolated compartment, filled with an inert gas, a number of wafer cleaning modules are arranged together with processing stations for wafer processing under high vacuum.

Figure 30 is an enlarged detail of the apparatus according to Figure 29.

Figure 31 is a detail of another configuration of the apparatus, wherein lithography oriented wafer processings take place.

Figure 32 is a transverse sectional view of another configuration, wherein a combination of wafer processings under high vacuum and lithography oriented wafer processings take place.

Figure 33 shows a modified configuration of the apparatus according to Figure 32 in a transverse sectional view.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

In Figures 1 and 29 the wafer transfer and processing apparatus 10 is shown. Thereby its wafer cleaning module 12 mainly consists of the lower chamber block 20, upper chamber block 22, cleaning chamber 24, located in between for cleaning of the wafer 26, cylindrical discharge passage 28, located aside this cleaning chamber for discharge of the cleaning medium 30, gaseous lock compartment 48 aside this passage 28, pulsators 32 for the reciprocating displacements of the central upper chamber block section 34 as upper wall of chamber 24 and the membrane section 96.

The upper mounting plate 86 is connected with mounting plate 82 by means of its two sections 88, see also Figure 2. By means of the bellow arrangements 90 the upper pulsator block 92 is secured to the lower side of this mounting plate 86.

Thereby by means of supply and discharge of preferably liquid medium 104 through not indicated valves toward and from these bellows the height and inclined positioning of this pulsator block 92 can be regulated, see Figures 18 through 23.

The outer section 94 of the upper chamber block 22 is mounted against the lower side of this pulsator block 92. Thereby this block is provided with recess 102 as part of the cleaning chamber 24.

By means of a screw connection the pulsators 32 are secured onto the central upper chamber block section 34. If required, such connection can be glued.

These piezo transducers are located within the pulsator chamber 98.

With this apparatus the application of the wafer transfer robots 18 for supply of a wafer, to be cleaned, toward module 12,and discharge of the cleaned wafer, see also Figures 29 through 33.

The wafer transfer, see Figures 18 through 23, is as follows:

For receiving a wafer 26, to be cleaned, by means of discharge of medium from bellows 90 the upper chamber block is moved upward over a small distance, see Figure 18^A.

Thereby by means of the transfer robot 18 the wafer 26 is moved toward its transfer position 110 underneath the upper chamber block 22.

Subsequently, by means of supply of medium toward the back end bellows 90 an inclined position of this upper chamber block 22 is established and whereby the reciprocating sidewall 112 of the chamber recess 102 is moved downward along the wafer, see Figure 18^B. Thereby a first centering of this wafer takes place by means of the scissor movement of this sidewall, see

Figures 20 through 22.

Thereupon, by means of medium supply toward the front end bellows 90 the front section of this upper chamber block 22 is moved downward, see Figure 18^{C}, and whereby by means of the scissor movement of wall 112 a final centering of the wafer takes place.

Subsequently, in this centric position the wafer is suctioned against the upper chamber wall 34. Such by means of drawing a vacuum through central channel 72.

Thereupon, the robot arm 44 is moved from underneath this chamber block 22, Figure 19^{D}, and thereafter this block 22 is moved downward toward against lower chamber block 20 by means of medium supply toward all bellows, whereby the lower side of the wafer enters the chamber recess 150.

In another wafer transfer system by means of medium supply toward the front end bellows at first the chamber block 22 is brought to an inclined position and whereby the arriving wafer comes to a stop against the sidewall 112 of the chamber recess 102 of this block, see Figure 19^{A}, with an accomplished centering of the wafer, see Figures 20 through 22.

Subsequently, by means of medium supply toward the back end bellows the back section of the reciprocating wall 102 is moved downward along the wa- edge 120. Thereby at the contact areas 118 an excentrically situated wafer is urged toward its centric position within recess 102.

Thereupon, here also the suctioning of the wafer against the upper chamber wall 34, see Figure 19^{B}, and after the removal of robot arm 44 the downward displacement of the upper chamber block 22 toward against the lower chamber block, with the wafer positioned within the cleaning chamber 24, see Figure 19^{C}.

After the wafer cleaning, by means of discharge of medium 104 from the bellows 90 an upward dispacement of the combination of upper chamber block with the wafer 26, suctioned against the upper wall 34, takes place, see Figure 23^{A}, and whereupon the robot arm 44 with its support section 122 is moved toward its wafer take-over position 204, see Figure 23^{B}.

After ending the vacuum suctioning, wafer transfer takes place onto this arm 44 and whereby after the upward displacement of the upper chamber block 22 the combination of arm 44 and wafer 26 is carried off, see Figure 23^{C}. Thereby possibly the suctioning of the wafer onto the support wall 122, as indicated in Figure 23^{D}.

In Figure 7 the module 12 according to Figure 1 1 is shown at the cleaning chamber 24 and the medium discharge gap. Thereby wafer cleaning in this chamber takes place by means of cleaning medium 30, with an urging

against each other of the stop wall sections 114and 116, and an at least almost sealing-off position of the combinations of wall sections 130 and 132, 134 and 136 and 138 and 140 of these blocks.

Thereby the anchored teflon PFA or PTFE or other linings 142 and 144, if used, see Figure 7C, enable a soft landing of the uoper chamber block section 114 onto the lower chamber block section 116.

Within the scope of the invention these blocks can be produced from any suitable material, such as titanium for the upper chamber block 22.

In the lower chamber block 20 the central supply channel 70 for cleaning medium 30 is located, whereas in the upper chamber block 22 channel 72 for cleaning medium 30 and/or gaseous medium 50 is positioned.

Furthermore, the wall section 130 consists of the section 146 in between the cleaning chamber 24 and the membrane section 96 and the section 148 in between this membrane section and the discharge passage 28.

The height of this chamber 24 is to a small extent larger than the thickness of the wafer, for instance approximately 100 µm, see Figure 11A.

The corresponding walls of both lower chamber block 20 and upper chamber block 22 are high-precision machined and flat. With the stop position of, the module wall 114 and 116, see also Figure 2, the other wall sections are only over a micro distance removed from each other, as for instance 2-5 µm for the sections 130/132, 134/136 and 138/140.

The discharge capacity of the discharge passage 28 through 8 branched channels is that considerable, that during the wafer cleaning with a set discharge pressure the differences in pressure, established by means of medium discharges, are limited to maximal 0,01 bar.

With no medium supply into chamber 24, due to expulsion of medium 30 as the result of mainly differences in pressure between the cleaning chamber 24 and the pulsator chamber 98, the height of the discharge gap 156 is reduced to such extent, that by means of an accompanying increase of the flow resistance this gap at least jointly functions as sealing-off member.

As a result, it is possible to stop the medium supply for some seconds.

As thereupon the mini supply of medium 30 is resumed, then both chamber 24 and discharge gap 156 are charged with medium until the original height of gap 156 is reached, with a recovery of the discharge of finished-off medium from chamber 24, as therein fresh cleaning medium is supplied through both channels 70 and 72.

Because the volume of the pulsator chamber is considerable, it is desirable, that with successive changes in pressure for the wafer cleaning, as from overpressure toward negative pressure, the pressure in this chamber is

regulated and by means of sensor 212 a corresponding pressure in the discharge passage 28 is established.

However, within the scope of the invention it is also possible, that such sensor is connected with the discharge passage, providing impulses toward the supply and discharge system of pulsator chamber 98.

The total weight of the central upper chamber block section 34, preferably produced from titanium, and including the pulsators 32, is extremely low, approximately 4 KG for an 8" wafer, with a resulting added downward thrust on this block section of approximately 0,01 bar. Consequently, the contra-pressure within the combination of cleaning chamber 24 and discharge gap 156 has to be an additional 0,01 bar higher.

With medium supply into chamber 24 the average upward thrust of the medium in the dischargegap section underneath the inner membrane section 208 is approximately the same as the downward thrust of the medium 50 in the pulsator chamber 98 on this section. In that way, this membrane section is in a mid position thereof during such medium supply.

Thereby during the downward compression stroke of the upper chamber block section 34 an expulsion of a small amount of medium 30 from the discharge gap 156 toward discharge gap 158 takes place.

Because only a very limited amount of cleaning medium is required, temporary less than 100 mm^3 per second for an 8" wafer, the medium discharge over a gap width of approximately 650 mm is extremely small.

In addition, this medium discharge can be local.

The buffer compartment 206 within the cleaning chamber 24, extending in lateral direction aside the wafer 26, with a volume of approximately 400 mm^3 for an 8" wafer, now also functions as medium discharge channel toward such local discharge. In that way, a sufficient uniform cleaning of in particular the upper side of the wafer as processing side is quaranteed.

During the upward expansion stroke of the central upper chamber block section the wall section 130 is taken along upward, with consequently a considerable reduction in pressure within the discharge gap 156. Thereby the inner membrane section 208 is moved downward again.

With the application of piezo transducers with a vibration frequency of 40000 Herz, also 40000 mini medium discharges per second take place, with per puls the discharge of less than 0,01 mm^3 medium.

A reduction of the pressure in the discharge passage with regard to the pressure within the pulsator chamber results in a reduction of the upward thrust of the medium in the discharge gap 212 underneath the membrane section.

With a very large drop in pressure even a temporary downward mini bending from the membrane end 214 on is accomplished. Thereby finally the central membrane section 152 is urged against the section 154 of the lower chamber block 20, see Figure 7^B and enlarged Figure 9^A.

This offers the ideal possibility to create considerable differences in pressure in the cleaning chamber during the wafer cleaning, as from high-pressure wafer cleaning, with a pressure of over 70 bar, toward even vacuum wafer cleaning.

In addition , it is possible to have wafer cleaning in an hermetically sealed-off cleaning chamber taken place during some time.

Thereby by means of medium supply into the cleaning chamber or a drop in pressure in the pulsator chamber the central block section 34 must be urged upward to abolish this bending by means of a further bending of the membrane section in upward direction around the membrane end 210 and by moving the membrane section 152 from the section 154 of the lower chamber block to establish a medium discharge from this cleaning chamber again.

Due to the stiffness of membrane section 96 a considerably higher pressure in chamber 24 than in pulsator chamber 98 is required, see Figure 9^B.

The functioning of the control system for the discharge of the cleaning medium is as follows:

In Figure 11^A after the arrival of wafer 26 in chamber 24 a pressurizing thereof with cleaning medium 30 takes place, whereby preferably temporary the reciprocation of the upper chamber wall 34 is nullified.

Through that, the wall section 146 of the upper chamber block 22 is urged upon the wall section 132 of the lower chamber block 20.

Within the scope of the invention it is also possible to use such pressurisation with a reciprocating upper chamber wall.

Thereby possibly a consireble difference in pressure between the pulsator chamber 98 and the discharge passage 28.

Thereby the pulsating wall section 146 is also reciprocated immediately on top of section 132, as indicated in Figure 10^D.

The resulting extreme whirlings of the medium within the extremely narrow passage 156 cause such a high flow resistance, that combined with the at least temporary sealing-off of chamber 24 by means of membrane section 152, urged upon the sealing-off section 154, a sufficient sealing-off of the cleaning chamber is guaranteed.

During the medium charge of chamber 24 by means of the accomplished upward displacement of the central block section 34 the total volume of both cleaning gaps 190 and 192 of chamber 24 is increased.

Thereby the pulsator can start to operate, with a resulting reciprocating action of block section 34, see Figure 11^B.

Subsequently, by means of a continued increase in pressure within pulsator chamber 98, with an accompanying decrease in volume of Chamber 24, a cleaning of the wafer under high pressure is accomplished.

With a considerably lower pressure within discharge passage 28 at least temporary by means of the sealing-off combination 152/154 at the membrane section 96 the sealing-off of the discharge gap 156 is maintained at least almost totally, see Figure 9^B.

However, with a further increase of the pressure in chamber 24 as the result of medium supply into this chamber and/or due to an increased pressure of the medium in the discharge passage, finally due to the thrusts, applied onto the membrane section 96, this sealing-off section over a micro distance is displaced from section 154, with a discharge of the cleaning medium from chamber 24 through both discharge gaps 156 and 158, together with the accomplished discharge gap section 160, as shown in Figures 7, 9^A, 10^A and 11^D.

Thereby in Figure 7^A the pressure diagram for this module 12 during this medium supply and discharge is shown.

Thereby in the cleaning chamber a negligible drop in pressure of the medium 30 from the central supplies 70 and 72 on, in the discharge gap section 156 an increased pressure drop, in gap section 160 a considerable drop in pressure and in gap section 158 again an increased pressure drop, and whereby in discharge passage 28 still an overpressure is maintained.

The resulting upward thrusts of the combination of the pressures in this chamber 24 and the gap sections is thereby equal to the combined thrust 162 of the medium in pulsator chamber 98 and the weight of the central block section 34 together with pulsators.

Thereby an increased medium supply results in a pressure increase in chamber 24 and consequently in the medium discharge gaps, resulting in an enlargement of these discharge gaps and an increased medium discharge.

This is also the case with an accomplished reduction of the pressure in pulsator chamber 98. Thereby, due to the temporary increased discharge, the height of these discharge gaps is gradually diminished, until a balanced condition is reached.

Thereby a discharge of gaseous medium 50 takes place from gaseous lock compartment 48 through discharge gap 168 toward the exterior 170 of this module.

During the discharge of the finished-off cleaning medium 30 this rinse

medium takes care of the removal of this medium 30 from this discharge passage 28.

In addition, through discharge gap 168 a discharge of this gaseous medium 50 takes place from the gaseous lock compartment 48 toward the exterior 170. However, due to the extremely narrow passage 168, with a micro height thereof, this discharge is almost nil.

In module 12', see Figure 4, the lower chamber block 20 in lateral direction beyond the gaseous lock compartment 48' is provided with the membrane section 76, with the creation of the central lower chamber block section 172 and the outer mounting section 80. This mounting section is airtight secured to support plate 82, with the creation of thrust chamber 36.

Thereby in between the stop wall section 174 of this central block section 172 and the stop wall 84 of mounting plate 82 a cylindrical micro gap 176 is located, if by means of thrust medium 104 in this thrust chamber 36 this central block section 172 at the stop wall section 178 aside the wafer transfer zone is urged against a corresponding section of the upper chamber block 22', see Figure 12^A.

Therewith at least temporary an at least almost total sealing-off of the medium discharge from chamber 24' toward discharge passage 28' and from gaseous lock compartment 48' toward this passage 28' and the surrounding area 170 is obtained.

Due to this almost contact making of block secties 130'/132', 134'/136' and 138'/140' the discharge of mediums from both chamber 24' and compartment 48' is almost nil, as on an enlarged scale is shown in Figure 12^A. However, with a positive thrust in downward direction by means of an accomplished difference in pressure between the combination of cleaning chamber 24' and pulsator chamber 98 at one side and the thrust chamber at the other side, this central block section 172 is urged downward, whereby the height of discharge gaps 156', 158', 160', 166' and 168' is increased. As the thrust medium in this thrust chamber 36 is a liquid, with a discharge of a small amount thereof by means of regulator-arrangement 180, a downward displacement takes place of this block section, whereby its stop wall 176 is urged against the stop wall 84 of the support plate 82.

As a result, these discharge gaps 156', 158', 160', 166', and 168' are opened, see Figure 12^C and on an enlarged scale Figure 12^D.

By means of a discharge of only approximately 200 mm^3 liquid from the chamber 36 and controlled by this regulator arrangement, providing a downward displacement of 5 µm of this central block section 172, periodically a discharge of finished-off cleaning medium is accomplished.

By means of buffer blocks 182 the modules are mounted onto support plate 184, see Figures 1 and 2, reducing the transfer of the module vibrations toward this support plate to a sufficient extent.

Furthermore, in at least the lower chamber block 20 both supply orifices 186 are located, with such inclined position thereof with regard to chamber 24, that by means of supply of medium 50 a thrust on the floating wafer 26 is maintained in radial direction, with a resulting rotation of this wafer. Such to establish a uniform cleaning.

Within the scope of the invention these orifices can be omitted.

The orifice 124 of both supplies 70 and 72 contains a saphire orifice 188 with a small passage, preferably smaller than 0,1 mm, see Figure 7.

The wafer cleaning is described in the PCT Application, serial Mo. PCT/NL89/00092 of the applicants and the above listed Dutch Patent Applications and whereby during this cleaning under pulsating double.floating condition whether or not an uninterrupted supply of medium takes place into both upper cleaning gap 190 and lower cleaning gap 192 of chamber 24, located on both sides of the wafer, see also Figures 24 through 28.

In Figures 24, 25 and 26 the system of wafer cleaning within both cleaning gaps 190 and 192 are shown on a highly enlarged scale.

Thereby in Figure 24 by means of at least almost only medium in liquid phase 30 in the upper cleaning gap 190 cleaning of the upper side of the wafer as processing side thereof and in the lower gap 192 cleaning of the lower side of this wafer with at least almost only gaseous medium take place under overpressure.

Thereby by means of the lagging effect of the wafer a hefty action of the ultra-fine atomized liquid particles takes place on the boundary layer 196 and the walls of the sub-miron valleys 198, see Figures 24^G and 24^H.

During the compression stroke of the chamber upper wall 34, Figures 24^A, 24^B and 24^C an imploding action takes place of the sub-micron vacuum bubbles and during the expansion stroke an exploding action of these bubbles, Figures 24^D, 24^E and 24^F.

Thereby with the CO_2 cleaning during this compression stroke an imploding action takes place of the gases, established during the preceding expansion stroke and during this expansion stroke the exploding action of the established liquid particles.

In Figure 25 thereby in the upper gap cleaning of the wafer takes place by means of a combination of liquid and gaseous medium 30, with here too, during the compression and expansion stroke of wall 34 and together with the lagging wafer a hefty action of the micro flows of medium, wherein

the liquid medium is ultra-fine atomized, on the wafer, see Figures 25^G and 25^H.

With the CO_2 cleaning by means of the combination of CO_2 and gaseous medium hereby too, during the compression and expansion stroke of wall 34 together with the lagging effect of the wafer, a hefty action of the micro flows of medium, in which the liquid CO_2 is ultra-fine atomized, takes place on the wafer.

In Figure 26 at the end of the wafer cleaning or possibly in between, by means of rinse medium 50, supplied through both central supply orifices and moving in lateral outward direction through both gaps, a rinsing takes place of these gaps after the expulsion therewith of residue cleaning medium.

Thereby the height of these gaps is temporary enlarged to accomplish a fast expulsion. However, thereby these heights can also remain the same.

In particular during the compression stroke expulsion of medium takes place from both gaps 190 and 192, whereas during the expansion stroke particularly supply of new rinse medium through both supply orifices takes place.

Within the scope of the invention every succession of different cleaning mediums is possible, as after an aggressive medium a less aggressive medium and finally no aggressive medium, with any medium in gaseous, vapor or liquid phase and whether or not in combination and whereby such cleaning under overpressure can be changed into cleaning under negative pressure or oppositely.

During such cleaning under vacuum an increased lagging effect of the displacing wafer 26 occurs, as is shown in Figures 27^A, 27^B and 27^C during the compression stroke of wall 34 and in Figures 27^D; 27^E and 27^F during the exoansion stroke of this wall, with consequently an increased action of the flows of medium on the wafer topograohy.

In Figure 28, after the vacuum cleaning according to Figure 27, expulsion of the finished-off cleaning medium 30 takes place by means of fresh cleaning medium in whether or not only gaseous phase.

Thereby by means of an increased vacuum in thrust chamber 36 a moving downward of the lower chamberblock section 172 toward against stop wall 174, see Figure 4, with the creation of a cylindrical discharge gap toward the discharge passage.

With the module according to Figure 1 such an enlarged height of the cleaning gaps 190 and 192 takes place by means of increase of the vacuum in the pulsator chamber, whereby the stop wall 202 of block section 34 is

urged against the stop wall 200.

As a result, an ideal expulsion of the finished-off cleaning medium takes place by means of supplied gaseous rinse medium 50.

The piezo pulsators are connected with the modulator 196, whereby at least the amplitude of the vibrations can be regulated.

Buffer arrangement 218 on top of the pulsators 32 provide a stop for restriction of the upward displacement of the pulsators.

The modules are provided with a cylindrical stop wall 200 as lower wall of the downward extension 224 of the upper pulsator block 92. In addition, the central upper chamber block section 34 is provided with stop wall 202.

Thereby in the upper stop position of block section 34 the height of the cleaning chamber 24 is maximal, for instance 50 um larger than the average height thereof during the wafer cleaning under pulsating action of this block section 34. In addition, the height of the discharge gap 156 is maximal, see Figure 15.

Furthermore, the bottom side of the upper mounting plate 86 provides buffer wall sections 218, and whereby the top section of the pulsators provide the contra buffer walls 220.

Thereby in this stop position for wall sections 200 and 202 a micro gap 222 is located in between both buffer wall sections 218 and 220, see Figure 15.

The functioning of this stop/buffer arrangement is as follows:

In Figure 13^A and strongly enlarged in Figure 13^B by means of an overpressure in pulsator chamber 98 with regard to the pressure in discharge passage 28 a sealing off of the discharge gap takes place by means of membrane section 152 and whereby due to medium supply the pressure in cleaning chamber 24 is increased toward beyond the overpressure in pulsator chamber 98 without medium discharge takes place.

Thereby the limitation of the volume increase of chamber 24 by means of the micro reciprocating medium layer in gap 226.

In Figure 14^A and strongly enlarged in Figure 14^B with an overpressure in pulsator chamber 98 with regard to the pressure in discharge passage 28 a medium buffer is maintained in this gap 226, preventing, that with an a pressure in the cleaning chamber higher than the pressure in this pulsator chamber, the volume of this chamber 24 is increased considerably.

This increased pressure now enables, that beyond a certain level thereof in cleaning chamber 24, during the downward compression stroke repeatedly the strongly increased upward thrust of the medium in discharge gap section 156 against membrane section 96 results in a lifting of the central membra-

ne section 152 from the sealing-off section 154 of the lower chamber block, with repeatedly establishing micro discharge gap 160.

In Figures 17^A, 17^B and 17^C systems are shown for wafer cleaning, with by means of the stop wall combination 200/202 the provision of very large differences in pressure.

Thereby in Figure 17^A with a very high pressure in pulsator chamber 98 and the discharge passage 28 the increase of a low cleaning pressure toward even a pressure beyond this pressure in this pulsator chamber. Such by means of the central supply of cleaning medium into chamber 24.

Furthermore, in Figure 17^B a considerable drop in pressure in this pulsator chamber for wafer cleaning under a considerably lower pressure, without a possible considerable increase of the volume of chamber 24.

Thereby temporary a considerable discharge of medium from chamber 24 through the wide discharge gap 156.

Furthermore, in Figure 17^C the transfer even from cleaning under high pressure toward cleaning under negative pressure.

Thereby temporary also a considerable discharge of medium from this cleaning chamber 24.

By means of the buffer functioning of the micro gap 226 in between both stop walls 200 and 202 temporary a considerable reduction of the vibration amplitude of the central block section 34.

In these temporary stop positions, Figure 17, the pulsating action of the top section 220 of the pulsators 32, see Figure 15.

In Figure 16^A by means of thrust medium in buffer gap 222, vibrating to a small extent, it is prevented, that with such cleaning under high pressure and a relatively narrow narrow gap 226 between stop walls 200 and 202 the reciprocations of the chamber upper wall are diminished.

In particular with cleaning under high pressure, as beyond 50 bar, the resistances to be conquered for the vibrating central block section are that great, that these vibrations possibly are reduced to zero and these pulsators transfer these vibrations toward the top sections 220, as is not wanted.

In this way, by means of the buffer functioning of the medium within this buffer gap 222, a considerably greater vibration amplitude of the upper chamber wall 34 than that of the pulsator top sections 220 is maintained.

Within the scope of the invention it is also possible, that in such module, dependent on the type of wafer cleaning, only such stop wall combination 200/202 or buffer combination 218/220 is used.

In Figure 5 module 12" is shown. Thereby the reciprocating displacement

of the central upper chamber block section 34" under pulsating condition takes place by means of liquid medium 104, supplied into pulsator chamber98" and discharged therefrom by means of whether or not a plurality of plunger-cylinder arrangements 230. Thereby such supply through whether or not a single supply/discharge channel 232 in the top of this chamber.

Thereby per supply 230 only a supply and discharge of 150 mm^3 to accomplish with 8 supply arrangements 230 for a 8" wafer an amplitude of 40 μm of the reciprocating displacements of this block section 34.

Consequently, the frequency of these vibrations can be considerable, approximately 50 Herz for a 40 μm amplitude and 100 Herz for a 20 μm amplitude.

This module is extremely suitable for cleaning under high pressure by means of the combination of an inert gas, as N_2, and a super critical fluid, as CO_2 or even solely CO_2.

Thereby after this cleaning under ultra-high pressure by means of a considerable drop in pressure the transfer of the liquid phase of this medium toward the gaseous phase, as is also the case with liquid medium, having a low boiling point. Such cleaning system is described in the above listed Applications.

For that purpose,the stop wall 200" of the upper block 92" is for a relatively great distance removed from the stop wall 202" of the block section 34 in its lowest position, for instance 100 μm.

With this wafer cleaning under pulsating double-floating condition and with medium supply through supply orifices 70" and 72", always per puls during the upward expansion stroke of this block section 34" discharge of cleaning medium 30 takes place from cleaning chamber 24" through discharge gap 156" toward discharge passage 28", as shown in Figure 5^A.

Thereby during the compression stroke this chamber 24" is sealed off.

In another pressure establishing system in pulsator chamber 98", cleaning chamber 24" and discharge passage 28" such discharge temporarily takes place during the downward compression stroke of this block section 34" and/or during the transfer phase of the compression and expansion strokes.

Thereby the cleaning gaps 190" and 192" for such module 12" have an average height of for instance only 60 um, with consequently,by means of displacements of this block section 34" of 50 μm the creation of very great differences in pressure in these gaps, with during the upward expansion stroke the transfer of at least part of the ultra-fine atomized liquid into gaseous phase. and during the compression stroke the transfer of such medium in gaseous phase into ultra-fine atomized liquid.

With an increased expansion stroke, whereby both walls 200" and 202" are at least almost contacting each other, the height of the discharge gap 156" is also considerably enlarged, with a temporarily increased discharge of the cleaning medium from chamber 24", as for the expulsion of the finished-off cleaning medium from this chamber by means of gaseous medium.

Thereby also temporary an increased pressure in gaseous lock compartment 48" for a temporarily increased supply of gaseous rinse medium toward discharge passage 28".

With a low discharge pressure in discharge passage 28" and a considerable overpressure in the pulsator chamber 98" with regard to the pressure in the cleaning chamber 24", a sealing-off of this chamber 24" takes place by means of the central section 152" of membrane section 96", urging thereby upon the sealing-off wall section 154" of the lower chamber block 20", see Figure 5^B.

Here too, with a considerable increase of the pressure of the cleaning medium in cleaning chamber 24", by means of the resulting upward thrust thereof against the central block section 34", an upward displacement is established thereof, with an accompanying widening of discharge gap 156" and whereby finally, due to the accomplished temporary considerable overpressures in this gap, a removal of membrane section 152" from section 154" takes place, with a discharge of cleaning medium.

Thereby the discharge of the cleaning medium per puls is that limited, that gap section 158" functions as buffer chamber for such gathering of this medium, that the medium flow toward the discharge passage 28" is uniform to such extent, that a sufficient rinsing of this passage 28" by means of gaseous medium 50, urged therein from the gaseous lock compartment 48" through discharge gap 166", is quaranteed.

With a temporary considerable drop in pressure in pulsator chamber 98" by means of the stop wall combination 200"/202", with eventually buffer medium in the narrow gap 226", the increase in volume of cleaning chamber 24" remains limited, as imaginary is shown in Figure 5^B.

Within the scope of the invention also for this module the wafer cleaning, as is shown in Figures 24 through 28, is applicable in a form, adapted there. Thereby such cleaning action can be followed by another wafer processing, as for instance oxidation or de-hydration bake.

In Figure 29 the installation 310, see also Figure 1, for wafer transfer, processing, storage and diagnose under a contamination controlled condition is shown.

This installation thereby mainly consists of the wafer transfer/processing compartments 314 and 316, with the adjacent wafer transfer/ de-gassing / storage/diagnose compartments 318 and 320, situated in a chip production plant.

At the level of floor 378 of the operating room 334 within the enclosed compartment 322 the floor 340 is located, functioning thereby as a horizontal separation wall in between the upper compartment 330 and the lower compartment 352, see Figure 32.

Modules 326 and 328 for wafer transfer and all-sided wafer cleaning, as are shown in Figures 1, 4 or 5, in adapted configuration are mounted against the vertical separation wall sections 336 and 338.

These sections of separation walls 324, extending in longitudinal direction of the installation 310, are placed under an angle with regard to each other and in tat way also these modules.

In addition, by means of at least one vertical separation wall 360 and such whether or not in combination with the sidewall of the processing equipment 332 the wafer transfer/processing compartments 314 and 316 are separated from each other.

This vertical separation wall 324 and the other vertical wall sections extend in upward direction from this floor 340 toward at least beyond the wafer transfer zone 362, causing the compartments 314, 316, 318 and 320, together with the corridor 364, to be separated at this transfer zone in horizontal direction.

These compartments 314, 316, 318 and 320 extend in upward direction toward into operator room 334 and whereby the upward sealing-off is accomplished by means of the cover sections 346, connected against the ceiling 354 of this room 334, see Figure 32.

In the wafer transfer compartments 318 and 320 per wafer transfer/processing compartment a wafer transfer robot 354 is located for supply and discharge of wafers 26 toward and from the cleaning modules 326 and 328, diagnostic stations 342 and series of wafer storage/degassing modules.

Some distance above the floor 378 the cleaning chambers of modules 326 and 328 are located, with supply and discharge of wafers 26 on tranfer level 362. At the wafer processing side supply and discharge toward these modules and therefrom takes place by means of transfer robots 356.

In the common upper section 498 of the upper compartment 330 the filter houses 358 for inert gas, which is lighter than air, as N_2, are secured and connected with a common supply duct 366 for this inert gas as upper medium 368.

Furthermore, by means of supply duct 374 supply of air as lower medium 372 takes place toward filter houses 370, providing air toward corridor 364.

In these filter houses 358 and 370 exchangeable filter cartridges are located.

Corridor 364 consists of the central corridor section 376, extending in longitudinal direction of the installation, and the branched corridor sections 378, located in between successive wafer transfer/processing compartments.

By means of level regulator 380 in these corridor sections the separation level 382 between both mediums 368 and 372 is kept on a level, located some distance underneath wafer transfer zone 362.

Thereby the orifices 370 for the lower medium 372 are located underneath this level.

In floor 340 the man holes 384 are located and whereby on top of these holes the person enclosures 386 are arranged.

In compartment 352 the person elevators 388 are located for displacement of a person toward and from this floor 340.

In the lowest position of such elevator by means of a displaceable wall this man hole is closed.

The lower section 550 of this person enclosure is made of an at least less deformable synthetic material, as teflon, in such way, that it functions as carrier for the upper section 552, which is also sufficiently non-deformable, and provided with a transparant head enclosure 554.

Furthermore, this lower section 550 is open at its bottom side and locally made heavier.in its section 548.

By means of a flexible section 556 the lower and upper section are secured to each other, enabling a considerable bending of upper section 552, for instance 60^0,

In addition, this upper section 552 contains coupling sections for securing the flexible arm sections 558.

Furthermore, the lower section 550 is provided with rolls for the displacement of such enclosure over floor 340.

Furthermore, this carrier section 548 is provided with sealing-off means for a leak-free securing thereof onto the test and cleaning facility 530, see Figure 29.

The medium supply and discharge tubings 390 and 392 for such enclosures 386 are coupled with the nipples 394, located in floor 340, for connection thereof with a supply and discharge of respiration air.

In that way,this respiration medium cannot contaminate the column ultra-

filtered lower medium 374, situated in corridor 364 above this floor 340.

Due to the relatively great distance in between separation level 382 and floor 340, approximately 0,3 meter, it is not possible, that during the maintenance of the equipment in this upper compartment 330, with accompanying displacements of persons therein, the lighter upper medium 368 can enter such enclosure and disturbs the respiration of such person.

By means of elevator 388 such person can enter this enclosure 386 through its open bottom side 548 and can withdraw therefrom.

Furthermore, in compartment 330 in racks 398 ultra cleaned components for the equipment are stored within the column ultra-cleaned upper medium 368.

In this installation the application of TV camaras for monitoring in operator room 334 the successive wafer transfers, correct functioning of the equipment and the maintenance personnel during the maintenance.

Furthermore, in floor 402 of the wafer transfer/processing compartments 314 and 316 the discharge ducts 404 are located for discharge of upper medium 368 and whether or not combined with processing medium, see also Figures 30 and 31, in downward direction toward the whether or not central discharge duct 406.

If required, as with open wafer processing stations, such discharge duct can be connected with an own discharge to simplify the separation of processing medium.

In addition, in wafer transfer compartments 318 and 320 in floor 408 of the cassette transfer tunnels 410 the discharge ducts 412 are located for discharge of medium 368,and such whether or not combined with contaminants, toward the central discharge duct 414.

Furthermore, in floor 340 of corridor 364 the discharge ducts 416 are located. These ducts are connected with the discharge duct 418.

Within the scope of the invention these ducts can be connected with lower compartment 352 as discharge duct.

The volumes upper and lower medium are limited and depend on the locally required cleanroom condition.

In the lower compartment 352 the secundary sections of the wafer transfer-, processing- and diagnostic equipment and accessories, as tanks, pumps and piping, are located.

If required, also in this lower compartment the location of processing reactors or even underneath, with supply and discharge of wafers by means of cassettes.

In Figure 29 the installation 310 consists of two rows 314 and 316 of

wafer processing stations, in which successive wafer processings take place under vacuum in groups 420, 422, 424 and 426 of high vacuum wafer processing modules.

Thereby within the scope of the invention any type of wafer processing, whether or not in batches or individual.

Furthermore, the number of processing modules can vary per station from a single module on, dependent on the type of wafer processing.

In addition, in between these wafer processing modules a wafer diagnostic station and/or a wafer orientation station can be arranged.

In Figure 30 a section of a modified installation 310' is shown at group 420' of high vacuum wafer processing stations.

With a number of high vacuum wafer processing stations, due to the extremely discharge volume of processing gases from such station toward the wafer transfer section 428 in front thereof, this section at least locally does not need to be separated with a vertical sidewall from wafer transfer compartments 318 and 320. Consequently, in that location the cleaning modules 326 and 328 together with the wafer transfer robot 356 can have a position within these wafer transfer compartments 318' and 320'.

After the wafer processing under high vacuum,mostly processing contaminants, as metal deposition, has to be removed from the wafer thoroughly.

For that purpose, if required, in exit module 430 any type of effective treatment of the wafer, as for instance the removal of such metal particles or other deposition by means of an etch process.

Subsequently, in module 328' a continued processing of this wafer, as cleaning thereof by means of ultra-fine atomized liquid, situated within a gaseous medium as carrier medium, takes place.

Such thorough post treatment of the wafer in whether or not a combination of modules is followed by a thorough removal of moisture, which during the post treatment has entered the interior of the wafer, therefrom, because this moisture start to function as contimination during the following wafer processing under high vacuum.

With a wafer cleaning by means of the combination of N_2 with a supercritical fluid, as CO_2, such removal of moisture is not required.

Such degassing of the wafer, even by means of the combination of high vacuum and an increased temperature, takes a possibly longer than 20 minutes.

For that purpose, in wafer transfer compartments 318 and 320 wafer degassing stations 444 are located, preferably consisting of a series of degassing modules 446, 448 and 450.

As the installations are provided with different wafer processing stations, as for wafer processing under high vacuum and lithography oriented wafer processing, and these installations are located aside each other, preferably an automatic transfer of the wafer cassettes takes place through tunnel 410, connecting the exit section 432 of such installation 310 or section thereof with the intrance section 434 of another installation 310' or section thereof.

Thereby in such receiver station 434 two arrangements 436 and 438 to receive cassettes 440 are located, which storage facilities are connected with the cassette supply and discharge device 442.

As thereby a first casseppe 440 is unloading wafers by means of wafer transfer robot 354, in the meantime the other unloaded cassette 440 can be returned toward discharge station 432 of the other installation by means of this device 442 and subsequently replaced by another, loaded cassette.

In Figure 31 a section of installation 310' is shown, wherein lithography oriented wafer processings take place in group 452 of wafer processing stations.

Here too, if required, the use of such degassing station 444', with modules 446' and 448', as in front of coating deposition station 452, wherein in the first module HMDS vapor primer is deposited onto the wafer 26 under high vacuum.

Here too, at the entrance 434' the storage arrangements 436' and 438' for two wafer supply cassettes 440.

Furthermore, here also the same discharge system for the inert gas 368 through discharge ducts 404' in lower wall 402', whereby its gathering takes place within gathering compartment 454, located immediately underneath this separation wall 402', see also Figure 4.

Furthermore, hereby also the discharge of inert gas 368 from the wafer transfer compartment 318' takes place through ducts 414', located in its lower separation wall.

In this installation, if not required, as at stepper station 456, the omittance of the separation wall in between such station and the wafer transfer compartment 318', because such station at least almost does not generates contamination and no processing gases have to be discharged.

Furthermore, for the coating deposition station 458 behind the exit module 328' still an additianal module 430' for wafer treatment is located.

Within the scope of the invention these modules can be exchanged or this second module omitted.

For such installation any other combination of wafer transfer/processing

stations and whether or not combined with wafer transfer/de-gasing/diagnose compartments, as shown in Figures 30 and 31, can be used and such in any size and number.

Furthermore, combinations of groups of high vacuum stations and other wafer transfer/processing stations are possible, including wafer transfer/ processing installations, wherein at least a total wafer processing cycle, with whether or not locally a repeat, if required, as for DRAM wafer processing technics with multiple layers of elements.

The maintenance of the columns inert gas 368 and air 372, including contamination control, is as follows:

In central corridor section 376 and branched corridor sections 378 a column highly filtered air 372 is maintained, with on top the column ultrafiltered inert gas 368.

By means of supply of this air through supply orifices 370 and its discharge through ducts 516, to a sufficient extent a contamination-free condition for this air is maintained, also during local maintenance activities.

In addition, within this heavier column air by means of the non-deformable lower sections of the contamination-free exterior of the person enclosures 386, which also during such maintenance remain immediately above the corridor floor 340, the whirling actions of the air are extremely limited.

Consequently, no breaking through of air in upward direction into the column inert gas in upward direction beyond the vertical sidewalls 324, 336, 338, 360 and 362 takes place.

In addition, thereby almost no transfer of the relatively heavy contaminants take place from this column air in ypward direction towards this column inert gas.

Furthermore, gradually even a transfer of relatively heavy contaminants, present in this column inert gas, takes place toward this column air.

In that way, this column inert gas in these corridor sections 376 and 378 functions as a buffer, with only a very restricted discharge thereof through discharge orifices 460 at the separation level 382, if required, as imiginary is shown in Figure 32.

Consequently, an ideal opportunity is accomplished to have the upper compartment section 358 of upper compartment 330 function as a common duct for the inert gas, which locally is supplied into this upper section through the centrally situated filter arrangements 358 or through the imaginary indicated filter arrangements.

As in the wafer transfer/processing compartments 314 and 316 the discharge ducts 404 are located in floor 402 and in the wafer transfer/de-

gasing/storage/diagnostic compartments 318 and 320 the discharge ducts 512 in their floor, this supplied inert gas is moved over this stationary column inert gas in these corridor sections 376 and 378 as contamination-free gaseous guide wall and over the vertical separation walls 324, 326, 360 and 362 into these compartments 314, 316, 318 and 320 and suctioned off through these discharge ducts 404 and 414.

Thereby these filter arrangements 358 are situated individually, with a spreading of the inert gas by means of this upper section 358.

Furthermore, the location and size of the discharge orifices in compartments 314, 316, 318 and 320 are adjusted to the local wafer transfer and processing in order to restrict the use of this gas as much as possible.

Such in cooperation with as many of discharge ducts 404 and 412, as required.

In addition, by means of the use of gather compartments 454 underneath wafer transfer/processing compartments, where required, in any place within such wafer transfer/processing compartment the downward flow of the inert gas can be maintained on the level, wanted.

Consequently, a very simple, but extremely effective supply and discharge system is accomplished for the inert gas.

Instead of maintaining the height of the separation level 382 by means of float switch 380 it is also possible to accomplish such level by means of a number of discharge orifices 460 at this separation level for air and/or inert gas, as imiginary is shown in Figure 32.

If this level is above such orifice,than exclusively discharge of air takes place, whereas, if this level is underneath such orifice, only discharge of inert gas takes place.

In another configuration this float switch 380 cooperates with these discharge orifices, with these discharge ducts as safety.

Thereby these orifices are positioned over some distance above the switching level of this float switch.

Thereby the opening of such discharge orifice can be regulated from closed on, and whereby during maintenance locally an increased discharge of inert gas through the local discharge orifices is established.

In Figure 33 installation 310" is shown, whereby the separation wall 340" solely as floor of corridor 364" is located in between the upper compartment 330" and the lower compartment 352".

In addition, the separation level 382" in between the column gas 368 and the column ultra filtered air 372 is lowered and whereby the vertical separation wall 324" extends upward from this floor over some distance beyond

this level.

Here too, the wafer transfer/processing/storage/diagnostic compartments 314" and 318" respectively 316" and 320" are combined, with no separation wall in between these compartments and the lower compartment 352".

Furthermore, in these compartments immediately above the separation level 464, which in height corresponds with the separation level 382" at the corridor 364", the discharge orifices 466 are located, which are connected with the discharge duct 358.

The gaseous medium 368, here also supplied through filters 358", is moved through these compartments 314"/318" and 316"/320" toward these discharge orifices 466.

Due to the relatively great distance between the wafer transfer zone 362" and these discharge orifices 466, combined with a great number thereof and an extremely low downward velocity of this gaseous medium, locally less than 1 mm per second, with a good spreading thereof, there where required, such compartment to a sufficient extent is provided with fresh inert gas.

Such in particular at this wafer transfer zone.

Such also because of the possible adjustment of this discharge by means of valves 468.

Furthermore, in these compartments supply of highly filtered an heated air 372 takes place immediately underneath this separation level 466, with a good spreading thereof.

This air, the same as the highly filtered air, supplied into corridor 364" through supply orifices 370", is suctioned off through lower compartment toward the discharge openings 472 in its floor.

Within the scope of the invention it is possible, that this vertical separation wall 324" whether or not locally or in part is omitted.

Such separation wall 324" thereby in particular functions to prevent, that contaminated air from the air column 372" in corridor 364" can be discharged through these compartments 314"/318" and 316"/320".

Within the scope of the invention it is also for this installation possible, that this vertical wall 324" extends in upward direction from floor 340" toward beyond the wafer transfer zone 362".

The independent discharge of the air from corridor 364" takes place through openings 416", located in floor 340".

The open passage 470 underneath compartments 314"/318" and 316"/320" enable, that components of the equipment, as piping, can freely extent therein and do not need to be lead through one or more walls.

In addition, this equipment is also accessable from lower compartment 352".

In addition, parts of this equipment or even the entire equipment can be displaced through this passage toward or from the upper compartment 330", in particular for replacement thereof.

Furthermore, for this installation 310" any position of the supply filters 358" for the inert gas 368 is possible, as, if required, on top of these compartments, as imiginary is shown in Figure 1.

By using series of wafer cleaning modules within the isolated compartment, filled with an inert gas, the installations 310, 310' and 310" have the following positive features:

1. An ideal use of the combination of upper compartment 330, lower compartment 352 and operator room 334 for the isolated location of wafer transfer and processing equipment, controlling, storage and diagnose, resulting in the following:

a) in this upper compartment 330 an improved interface of the equipment sections 332 with other equipment sections and with a considerably reduced spacing in between;

b) possibly uniform distances between these equipment sections 332;

c) in this upper compartment 330 a considerably reduced maintenance of only these equipment sections 332, with a positive contribution to the considerably reduced generation of contamination; and

d) almost no equipment sections above the wafer transfer/processing zone 362 in continuous open position thereof, with a negligible generation of contamination.

Consequently, also a negligible and controlled generation of contaminants by the equipment sections 332 and other equipment, located within the upper compartment.

2. In this upper compartment 330 the effective use of submicron filtered inert gas 368, as N_2, instead of air, containing moisture and other, whether or not organic contamination.

3. An effective removal of deposition of eventually generated contaminants from the wafers by means of an all-sided wafer cleaning in a series of wafer cleaning modules 326, 328 and 430.

4. By making use of the vertical separation wall 324 and the buffer column highly filtered inert gas 368 above the column highly filtered air 372, no transfer of contaminants from the corridor sections 376 and 378 toward the compartments 314, 316, 318 and 320 or combinations thereof.

5. In the upper compartment 330 a negligible transfer of contaminants toward the equipment sections 332 during its maintenance by means of the following:

a) the inert gas as environmental medium, containing no water vapor and other contaminants;

b) a contamination-free person enclosure 386, with an own discharge of the respiration air for the person within; and

c) almost no whirling actions by means of the application of the separation wall 324, together with an almost static column inert gas 368.

6. An optimal and effective use of wafer transfer robots 354 and 356, with a minimal generation of contaminants.

7. In these compartments 314, 316, 318 and 320 or combinations thereof an additional optimal interface condition for all equipment by means of the wafer transfer between the equipment on a single, standard level.

8. An effective degassing of the wafers in sealed-off degassing modules 446, 448 and 450, with an own discharge of produced vapors and gases.

9. The heavier processing medium, discharged from the processing modules into these compartments, moves downward within the column inert gas toward the discharge orifices 404, 412 and /or 466, whereas with the existing installations often the ascent takes place of lighter processing gases and vapors within the cleanroom air.

10. In compartments 314, 316, 318 and 320 or combinations thereof a fraction of the whirlings above the wafer transfer zone, present in the existing installations.

11. No temporary, extremely unfavorable conditions in these compartments 314, 316, 318 and 320 or combinations thereof, as with existing installations due to the uncontrollable temporary proximity of personnel, generating contamination, whereby within the whole transfer/processing/control compartment a considerable laminar downward flow of ultra cleaned cleanroom air has to take place.

Consequently, with the installations 310, 310' and 310" the inert gas almost only is required as static environmental medium, with a minimal downward discharge thereof through compartments 314, 316, 318 and 320 or combinations thereof for the extremely restricted downward discharge of minimal quantities of generated contamination and processing medium through these compartments.

Also because of the restricted size of the upper compartment 330, the total consumption of inert gas is only a fraction of the total consumption of cleanroom air with the existing installations, often less than 1 %.

Consequently, an ideal local supply of this inert gas 368 is possible through mini filters, located in the top section of this upper compartment 330.

Furthermore, for this installation all other configurations and methods in whether or not adapted form, as described in the Dutch Patent Applications, serial Nr's 9000579, 9000902, 9000903, 9001177, 9001400, 9001862, 9000374, 9000375, 9000376 and 9100237 of Applicants, are applicable.

Furthermore, structures and methods of this installation in whether or not adapted form are applicable in these installations, listed above.

In Figure 8 the module is suitable for considerable differences in pressure between the pulsator chamber 98 and the discharge passage 28. Such for in particular wafer cleaning under high pressure, as with N_2 combined with a supercritical fluid, as CO_2.

Furthermore, thereby the possible replacement of gaseous lock compartment 48 by the outer environment 170 as supplier of the inert gas to maintain the gaseous lock within gap 166, see Figure 7, together with urging of this gas toward the discharge passage 28 for rinsing thereof.

In that case the inert gas compartment 330 of installations 310, 310' and 310", see Figures 29 through 33, functions as such environment.

The lower wall section 230 of the upper chamber block 22 has preferably at the central section 152 of membrane section 96 a slightly lower level, for instance 5 µm, than the adjacent wall sections 232 and 234, see Figure 8^C. Oppositely, the cooperating section of the lower chamber block can be provided with an upwardly extending wall section at this central membrane section 152.

With no pressure build-up in chambers 24 and 98 and no vibrating block section 34, together with an urging of chamber blocks 20 and 22 against each other at their stop walls 114 and 116,this cylindrical section 152 under spring load is urged upon corresponding section 154 of block 20.

As this membrane section is relatively stiff, during the upward expansion stroke of block section 34 it is jointly drawn upward around the cylindrical bending line 210, and such against this spring load.

Finally, depending on the pressure of the cleaning medium within the discharge gap section 156 with regard to the pressure in pulsator chamber 98 and in discharge passage 28, this section 152 is jointly moved upward over a micro distance, with the temporary creation of the micro passage 160.

With the subsequent downward compression stroke of block section 34 this stiff membrane section 96 is jointly drawn downward by this block section against the upward thrust of the further compressed cleaning medium within discharge gap section 156, with the again accomplished urging of section 152 against section 154, and an established sealing off of chamber 24.

The duration and extent of such lifting of section 152 from section 154 depends on the stiffness of membrane 96, the difference in pressure between both chambers 24 and 98 and discharge passage 28 and the vibration amplitude of block section 34.

Such stiffness of membrane section 96 depends on the differences in pressure for this cleaning module, with a maximal stiffness for wafer cleaning under a maximum average pressure , for instance 80 bar and pressure fluctuations of 40 bar.

With a maximal set pressure in pulsator chamber 98, with an accompanying considerable downward thrust thereof on membrane section 96, a discharge of cleaning medium from chamber 24 takes only place after the build-up of a considerable pressure therein.

With a sudden considerable drop in pressure in pulsator chamber 98 an increased discharge of cleaning medium 30 from chamber 24 takes place until again stabilisation occurs in supply and discharge of this medium toward and from this chamber.

With no supply of medium 30 into chamber 24 at first, due to a still continued expulsion of this medium the positive difference in pressure between pulsator chamber 98 and chamber 24 will increase, with consequently an increased urging of section 152 upon section 154 and finally an optimal sealing-off condition.

Figure 6 shows module 12''', whereby the lower chamber block 20''' is also provided with a central section 240, which by means of supply and discharge of liquid medium 104 toward and from the lower pulsator chamber 244 is reciprocated under a low frequency.

Thereby the same cleaning of wafer 26 in chamber 24''', as described for the module according to Figure 1.

The cylindrical stop combinations 200'''/202''' for these block sections 34''' and 240 provide the limitation of the block displacements, preventing an unallowable deformation of membrane sections 96''' and 242.

Thereby preferably the frequencies of the block vibrations are different, with consequently variation of the resultant amplitude to a great extent.

Periodically considerable amplitudes are established, whereby discharge of medium from chamber 24''' toward discharge passage 28''' is accomplished between membrane sections 162''' and 260, moved away from each other.

Within the scope of the invention it is also possible, that in another module configuration only the central lower chamber block section 240 vibrates.

Furthermore, that one of these pulsators is another type of pulsator,

as for instance a piezo transducer.

In Figure 9 a modified configuration of the medium discharge system for the cleaning module is shown.

Thereby the use of two membrane sections 96' and 262 as part of upper chamber block 22, with in between the cylindrical sealing-off section 266.

In Figure 9^A medium charge of cleaning chamber 24' takes place and whereby the overpressure of medium 50 in pulsator chamber 98' and section 264 thereof above membrane section 262 with regard to the pressure of medium 30 in chamber 24' provides the urging of lower wall 278 of this section 266 in downward direction upon the corresponding wall section 280 of lower chamber block 20'.

Such also during the reciprocation of central block section 34', because membrane section 96' absorbs these pulsations.

In Figure 9^B charging with medium of chamber 24' has taken place and whereby the pressure in this chamber to a small extent is higher than the pressure in pulsator chamber 98'.

Thereby an increase in volume of this chamber 24' is accomplished, with an accompanying upward displacement of block section 34', including membrane section 96' and sealing-off section 266, until this sealing-off section with its upper wall 276 is urged against stop wall 200', located within pulsator chamber 98'.

Thereby stop wall 202' of this block section 34' not yet is urged against this stop wall section 200'.

Consequently, the combination of discharge gap 156' and its extension 268 is created and whereby membrane section 262 at its inner end 282 is jointly moved upward.

Thereby this combination of discharge gaps function as buffer compartment in buffering cleaning medium 30, during the pulsating action of the upper chamber wall 34' urged from this chamber 24' and backward.

Thereby the negative pressure within discharge passage 28' and gap section 158', extending partly in inward direction toward underneath this membrane section 262, still provides such thrust in downward direction of the pressure of medium 50 in pulsator chamber 98, that central part 270 of this membrane section 262 still is urged upon wall section 272 of lower chamber block 20'.

In Figure 9^C by means of a continued supply of cleaning medium 30 into chamber 24' the pressure in this chamber is still further increased, whereby finally the resultant thrust on membrane section 262 causes the section 270 at least temporary to lift from wall 272 over a micro distance, accom-

plishing a discharge of finished-off cleaning medium 30 through discharge gap 274 and gap section 158' toward discharge passage 28'.

Within the scope of the invention any other build-up in pressure for this medium sealing-off/pass-through system is possible, with whether or not the application of a stop system and including wafer cleaning under high pressure or negative pressure.

The combination of membrane sections 96' and 262, with in between the displaceable sealing-off section 266, can be considered as an enlarged membrane section, whereby membrane part 96' thereof functions as flexible element in between this sealing-off section 266 and the pulsating block section 34' and the other membrane part 262 functions as flexible element in between this sealing-off section 266 and the outer block part 94'.

In Figure 9^C in addition in phase II is shown, that graduaaly the cleaning under high pressure is changed into a total discharge of the cleaning medium.

For that purpose, gradually the pressure in pulsator chamber 98' is decreased, whereby due to the overpressure in chamber 24' the upper wall 276 of sealing-off section 266 remains urged against stop wall 200', with due to the accompanying increased upward thrust against membrane section 262 at least temporary a continuously maintaining of discharge gap 274 in between membrane wall 270 and contra wall 272 of lower chamber block 20'.

Thereby still stop wall 202' of block section 34' is not urged against stop wall 200.

However, with a sudden drop in pressure this will be the case, causing this stop combination to function as safety.

As a result, an ideal system for cleaning under high pressure is accomplished, with still the possibility of a negative pressure in discharge passage 28', whereby gaseous lock compartment 48' can be omitted and the gaseous medium, required for its supply into this passage, can be withdrawn from the outer module environment, as the inert gas compartment 330 of the installations according to Figures 29 through 33.

In the at least almost joined position of walls 278 and 280, see Figure 9^A, the height of gap 288 in between block wall sections 284 and 286 near chamber 24' is still at least 10 μm, depending on the pulsation amplitude.

Consequently, during the wafer cleaning, see Figure 9^B, the height of this gap section 288 is sufficient to have the pulsating reciprocations of upper chamber wall 34' taking place at least almost jam-free, as is wanted with wafer cleaning under ultra-high pressure.

With the wafer supply systems according to Figures 18 through 22 it is

also possible, that after centering of the arrived wafer within the recess 102 of the upper chamber block 22 the support blade of the robot arm is drawn from underneath the wafer, with entering of the chamber recess in lower chamber block 20 by the wafer in a tilted position thereof, as imiginary is shown in Figure 18[D] with position 292.

Such is possible due to the extremely small height of the wafer transfer gap in between both chamber blocks, enabling a negligible tilting of the wafer and no unallowable forces, applied thereon.

For an easy entering the recess 122 by the tilted wafer, this recess has a somewhat larger entrance diameter together with an inclined sidewall.

CLAIMS

What is claimed is:

1. Apparatus for wafer transfer and processing, consisting of at least one wafer cleaning module, and in addition:

a) a combination of lower chamber block and upper chamber block;

b) a cleaning chamber, located in between these blocks in at least one central recess, for cleaning a wafer;

c) in this block arrangement in lateral direction aside this chamber a discharge passage for the cleaning medium;

d) means for removal of said chamber blocks from each other for wafer transfer toward and from said cleaning chamber and displacing toward each other for wafer cleaning; and

e) a pulsator for during at least the wafer cleaning in said cleaning chamber by means of the reciprocation of a chamber wall under vibrating action, providing an at least temporary variation of the height of said cleaning chamber;

comprising such means, that during the wafer cleaning, with an at least temporary established medium discharge gap in between said chamber blocks from said cleaning chamber toward said discharge passage, a sealing-off system is established by means of at least gaseous medium.

2. Apparatus as defined in Claim 1, comprising such cooperating stop walls, that in joined condition of said walls at least jointly temporary said mini medium discharge gap in between said cleaning chamber and said discharge passage is accomplished.

3. Apparatus as defined in Claim 2, comprising such means, that thereby said medium discharge gap extends uninterruptedly in radial direction during part of the wafer cleaning action.

4. Apparatus as defined in Claim 2, wherein thereby at least one of said stop walls as stop wall section is at least jointly part of whether or not an extension of one of said chamber blocks in lateral direction beyond said discharge passage.

5. Apparatus as defined in one of foregoing Claims, containing such means, that as thereby said chamber blocks comprise in addition cooperating, in radial direction uninterrupted wall sections, extending in lateral direction outward said discharge passage, during the wafer cleaning said combination of wall sections at least almost entirely seals off said discharge passage in lateral direction from the outer environment.

6. Apparatus as defined in Claim 5, comprising such means, that in cleaning position of said chamber blocks by means of gaseous medium a sealing

off system is established for said discharge passage in laterally outward direction.

7. Apparatus as defined in Claim 5, wherein it comprises such means, that as thereby at said wall sections in between said blocks a gaseous lock compartment is located, extending in radial direction, gaseous medium, supplied into said compartment, prevents that cleaning medium, arrived in said discharge passage, can escape therefrom in laterally outward direction in between said wall sections.

8. Apparatus as defined in Claim 7, comprising such means, that medium supply into said gaseous lock compartment for maintaining a gaseous lock takes place through a laterally outward extension thereof.

9. Apparatus as defined in Claim 8, wherein said extension of said gaseous lock compartment extends in laterally outward direction toward the exterior of said chamber block arrangement for supply of medium toward said compartment from the environment ouside said block arrangement.

10. Apparatus as defined in Claim 7, comprising such means, that as said gaseous lock compartment comprises an in vertical direction enlarged section, connected with an individual supply of filtered gaseous medium, during the joining of said stop wall sections of said chamber blocks the discharge of this gaseous medium from said compartment toward said discharge passage is limited.

11. Apparatus as in Claim 10, wherein said chamber blocks in addition comprise a combination of cooperating , in radial direction uninterrupted wall sections, extending in lateral direction outward said gaseous lock compartment and said combination of wall sections during the wafer cleaning seal off said gaseous lock compartment in outward direction to such extent, that thereby the escape of medium from said compartment in laterally outward direction at least is limited.

12. Apparatus as defined in Claim 11, comprising such means, that thereby the pressure of the medium in said compartment during the discharge of cleaning medium is higher than the pressure of the medium in said discharge passage.

13. Apparatus as defined in Claim 7, comprising such means, that said wall sections, located in laterally outward direction of said gaseous lock compartment, jointly for at least part thereof are said stop wall sections.

14. Apparatus as defined in one of foregoing Claims, wherein, as said chamber blocks comprise the following corresponding wall sections:

a) stop wall sections;

b) in radial direction uninterrupted wall sections, extending in laterally

outward direction from said discharge passage; and

c) in radial direction uninterrupted wall sections in between said cleaning chamber and said discharge passage,

it further comprises such means, that in joined position of said stop wall sections the following medium discharge gaps are established:

a) outward said discharge passage a discharge gap for supply of gaseous medium toward said discharge passage; and

b) at least temporary in between said cleaning chamber and said discharge passage an in radial direction uninterrupted discharge gap for discharge of cleaning medium from said cleaning chamber.

15. Apparatus as defined in Claim 14, comprising such means, that as said chamber blocks in addition comprise the following corresponding wall sections:

c) in radial direction uninterrupted wall sections, extending in laterally outward direction from said gaseous lock compartment,

in joined position of said stop wall sections in addition the following medium discharge gap is established:

c) outward said gaseous lock compartment a micro gap in between said wall sections, with possibly a local joining.

16. Apparatus as defined in Claim 15, wherein it comprises such means, that the flow resistance for medium in said gaps is that considerable, that during the wafer cleaning in said gaseous lock compartment an overpressure is maintained with regard to the pressure of the medium in lateral direction outward said gaseous lock compartment.

17. Apparatus as defined in Claim 14, wherein, as said chamber block walls, extending in laterally outward direction from said cleaning chamber, in addition for a considerable part thereof comprise transfer zones, along which the wafer is transferred toward and from said cleaning chamber, said stop wall sections are located at least outside the transfer zone of the wafer, cleaned in said cleaning chamber.

18. Apparatus as defined in Claim 17, wherein said wall sections, located in lateral direction immediately outward said gaseous lock compartment, at least aside the transfer zone for the cleaned wafer are stop wall sections.

19. Apparatus as defined in one of foregoing Claims, wherein, as thereby:

a) with a chamber block a central chamber block section, extending in lateral direction beyond said cleaning chamber, by means of a cylindrical membrane section is connected with an outer section of said block;

b) said discharge passage is located in lateral outward direction over some distance away from said membrane section;

c) a cover is pressure-tight secured against said outer block section, with the creation of a pulsator chamber; and

d) in said pulsator chamber a pulsator arrangement is located for a pulsating reciprocation of said central chamber block section, it comprises such means, that as in said pulsator chamber a medium is situated, jointly by means of this medium said sealing-off system for said cleaning chamber is accomplished.

20. Apparatus as defined in Claim 19, wherein said membrane section comprises a cylindrical sealing-off wall section, corresponding with a contra sealing-off wall section of the other chamber block, said discharge gap extends inwardly from said discharge passage toward at least said sealing-off wall section and it comprises in addition such means, that by means of a resulting thrust of at least jointly the thrust mediums in said pulsator chamber and said discharge gap said membrane sealing-off wall section is temporary urged onto said contra sealing-off wall, with an almost total sealing off of the discharge of cleaning medium from said cleaning chamber.

21. Apparatus as defined in one of foregoing Claims, comprising such means, that at least jointly during the wafer cleaning in said pulsator chamber an overpressure of the thrust medium is maintained with regard to the pressure in said discharge passage.

22. Apparatus as defined in Claim 21, wherein thereby said sealing-off wall section of said membrane section is located beyond the center of said membrane section at the side of said discharge passage.

23. Apparatus as defined in Claim 22, comprising such means, that thereby at least temporary during the wafer cleaning, with whether or not medium discharge taking place from said cleaning chamber, a considerable positive difference is maintained between the pressure in said pulsator chamber and said discharge passage.

24. Apparatus as defined in Claim 21, comprising such means, that thereby in unloaded position of said chamber blocks said sealing-off wall section extends downward over a micro distance from the adjacent sections.

25. Apparatus as defined in one of foregoing Claims, comprising such means, that in the joined stop position of said chamber blocks the height of said cleaning chamber is greater than the thickness of said wafer.

26. Apparatus as defined in Claim 25, comprising such means, that with a certain pressure in said pulsator chamber by means of supply of medium into said cleaning chamber therein such pressure build-up takes place, that said sealing-off wall section of said membrane section is temporary

and at least locally lifted from said contra sealing-off wall section of the other chamber block, with temporary the creation of an at least locally uninterrupted mini discharge gap from said cleaning chamber toward said discharge passage.

27. Apparatus as defined in Claim 26, wherein in said pulsator chamber a stop wall is located and said central chamber block section comprises such corresponding stop wall section, that by means of said stop wall arrangement the displacement in vertical direction of said central block section is limited.

28. Apparatus as defined in Claim 27, comprising such means, that during the wafer cleaning by limiting the maximal volume of said cleaning chamber by means of said stop wall arrangement, it is prevented, that the pulsating reciprocations of said central block section is nullified.

29. Apparatus as defined in Claim 28, wherein for that purpose said combination of stop wall sections has such large combined surface, that thrust medium, situated in between, functions as damper.

30. Apparatus as defined in Claim 27, comprising such means, that as for discharge of cleaning medium with an at least almost constant pressure in said discharge passage temporary the pressure in said cleaning chamber has to decrease, such is accomplished by means of a gradual reduction of the pressure in said pulsator chamber and use is made of said stop wall arrangement within said pulsator chamber.

31. Apparatus as defined in one of foregoing Claims, wherein said membrane section comprises a sealing-off section, a first flexible membrane section in between said sealing-off section and said pulsating central chamber block section and a second flexible membrane section in between said sealing-off section and said outer chamber block section.

32. Apparatus as defined in Claim 31, wherein thereby in said pulsator chamber a stop wall is located and said sealing-off section comprises a contra stop wall for limiting the displacement of said sealing-off section from its sealing-off position.

33. Apparatus as defined in Claim 32, wherein said cylindrical sealing-off section at least locally over some distance is flat.

34. Apparatus as defined in Claim 32, wherein said stop wall of said sealing-off section extends upward over some distance from said adjacent flexible membrane sections and at least locally is flat.

35. Apparatus as defined in Claim 32, comprising such means, that thereby in the stop position of said stop wall of said sealing-off section against said corresponding stop wall in said pulsator chamber the height

of the discharge gap section, extending from said cleaning chamber toward underneath said first membrane section is that large, that the pulsating reciprocation of said central block section maximal to a small extent is reduced by means of the medium within said discharge gap section.

36. Apparatus as defined in Claim 32, wherein thereby said second flexible membrane section comprises a second sealing-off wall section, displaceable in vertical direction, and corresponding with a sealing-off wall section of the other chamber block, and a discharge gap extends inwardly from said discharge passage toward at least said second sealing-off wall section.

37. Apparatus as defined in Claim 36, wherein thereby said second sealing-off wall section is located near the end of said second membrane section at the side of said discharge passage.

38. Apparatus as defined in Claim 35, comprising such means, that in the stop position of said stop wall of said first sealing-off section a micro discharge gap is accomplished in between said first sealing-off section and said corresponding wall section of the other chamber block.

39. Apparatus as defined in Claim 38, comprising such means, that up to a certain pressure build-up in said cleaning chamber in said open pass-through position of said first sealing-off section said second sealing-off section still is urged against said corresponding section of the other chamber block and above a certain pressure build-up in said cleaning chamber with regard to the pressure of the medium in said pulsator chamber and said discharge passage said second sealing-off section is lifted from said corresponding sealing-off section, with the accomplishment of medium discharge.

40. Apparatus as defined in Claim 36, comprising such means, that as in said pulsator chamber a first stop wall section of said central chamber block section with a corresponding stop wall in said pulsator chamber functions to limit the upward displacement of said block section, in the stop position of the second stop wall section as part of said first sealing-off section of said membrane section against said corresponding second stop wall within said pulsator chamber said first stop wall section is still over some distance removed from said corresponding wall in said pulsator chamber.

41. Apparatus as defined in one of foregoing Claims, wherein, as onto said pulsating central upper chamber block section at least one pulsator is secured, the upper section of said pulsator is a damper wall, within said pulsator chamber a corresponding damper wall is located and the

distance in between is that limited, that in combination with a considerable area thereof the vibration of said upper pulsator section is damped.

42. Apparatus as defined in Claim 41, wherein thereby the height of the gap in between said damper walls is such, that with a maximal attainable volume of said cleaning chamber the upward displacements of said upper section of said pulsator is damped to such extent, that said damper functions as compressible stop.

43. Apparatus as defined in Claim 41, comprising such means, that in the stop position of the first stop wall section to limit the maximal volume of said cleaning chamber, said damper wall of said pulsator does not make a mechanic contact with said damper wall within said pulsator chamber.

44. Apparatus as defined in one of foregoing Claims, comprising such means, that opening and sealing-off of the medium pass-through in said discharge gap at said membrane sealing-off section mainly takes place by means of accomplished differences in pressure of the mediums, acting on both sides of said membrane section.

45. Apparatus as defined in Claim 44, comprising such means, that within the narrow discharge gap sections, extending outward from said cleaning chamber toward said sealing-off section of said membrane section, in open condition thereof by means of expelled medium such high flow resistance is created, that thereby the reduction in pressure in said discharge gap at said membrane section, combined with the pressure in said pulsator chamber, accomplish at least a narrowing of the pass-through gap at said sealing-off section.

46. Apparatus as defined in Claim 44, comprising such means, that thereby, depending on the supply of medium into said cleaning chamber, the micro pass-through gap at said sealing-off section at least temporary is opened to a more or less extent.

47. Apparatus as defined in Claim 39, comprising such means, that thereby the combination of the stiffness of said second membrane section, the extent of deformation thereof during its urging against said corresponding sealing-off section of the other chamber block and the position of said second sealing-off section with regard to the rest of said membrane is such, that the pressure in said pulsator chamber and said cleaning chamber can be considerably higher than the pressure in said discharge passage.

48. Apparatus as defined in one of foregoing Claims, comprising such means, that during the wafer cleaning the pressure in said discharge gap is approximately the same as the average pressure in said cleaning chamber

during the successive compressions and expansions of the cleaning medium in said chamber by means of said pulsator arrangement.

49. Apparatus as defined in Claim 48, wherein thereby the length of said discharge gap in between said cleaning chamber and said discharge passage is that large,with such micro height thereof, that jointly by means of the accomplished great flow resistance for the cleaning medium, passing through, said gap functions as buffer compartment.

50. Apparatus as defined in Claim 48, comprising such means, that thereby during the regulation of the pressure of the medium in said pulsator chamber for the wafer cleaning, the pressure in said discharge passage is adapted accordingly.

51. Apparatus as defined in one of foregoing Claimsm comprising such means that for the pulsating reciprocation of said central chamber block section any type of pulsator is applicable in a configuration, adapted accordingly.

52. Apparatus as defined in Claim 51, wherein said pulsator is a piezo transducer, with an ultra-high vibration amplitude.

53. Apparatus as defined in Claim 51, wherein said pulsator is a hydraulic pulsator with supply and discharge of liquid medium toward and from said pulsator chamber, with a low frequency thereof.

54. Apparatus as defined in Claim 53, comprising such means, that thereby a regulable amount of medium is supplied and discharged toward and from said pulsator chamber.

55. Apparatus as defined in Claim 51, wherein both chamber blocks comprises a pulsating reciprocable central chamber block section, against each of the outer sections of said chamber blocks a cover is airtight secured, with the creation of two pulsator chambers and within said chambers a pulsator arragement is located for the reciprocable displacement of said central block sections.

56. Apparatus as defined in Claim 47, wherein this distance in between said cooperating walls of said first stop wall combination is that considerable, that the pulsating displacements of said central block section in direction of said stop wall arrangement is damped ot only a small extent.

57. Apparatus as defined in one of foregoing Claims, comprising such means, that thereby during the cleaning in said cleaning chamber under overpressure a negative pressure is maintained in said discharge passage.

58. Apparatus as defined in Claim 57, comprising such means, that thereby the outer environment for said module functions as supplier of gaseous medium, required for maintaining a gaseous lock in lateral direction

outward said discharge passage and rinsing of said passage.

59. Apparatus as defined in one of foregoing Claims, wherein thereby a series of wafer cleaning modules and wafer processing modules are arranged within a compartment, wherein at least jointly an inert gaseous medium is situated and whereby a series of wafer transfer robots are used for at least horizontal wafer transfer.

60. Apparatus as defined in Claim 59, wherein said compartment by means of a cover is separated from an adjacent operator room, said cover extends in downward direction toward at least beyond the horizontal wafer transfer zone of the robots and underneath said upper compartment a lower compartment extends, comprising air and in addition such means, that said upper compartment is accessable from said lower compartment for maintenance.

61. Apparatus as defined in one of foregoing Claims, wherein, as in said upper chamber block said central block section as reciprocable upper wall of said cleaning chamber by means of a cylindrical membrane section in outward direction is connected with a mounting section, in said lower chamber block a second central block section is located, extending over some distance in laterally outward direction beyond said discharge passage and by means of a cylindrical membrane section in laterally outward direction is connected with an in radial direction uninterrupted mounting section and said apparatus in addition comprises means for a displacement in downward direction of less than 0,1 mm of said lower central block section in joined position of said chamber blocks toward a stop wall arrangement and in return to accomplish a medium discharge from said cleaning chamber.

62. Apparatus as defined in one of foregoing Claims, comprising such means, that by means of a displacement appliance said displaceable chamber block is displaceable from it open wafer transfer position for supply and discharge of a wafer toward and from said cleaning chamber toward its sealed-off wafer cleaning position and in return.

63. Apparatus as defined in Claim 62, comprising in addition a combination of support block and cover block, secured to each other, and whereby one of said chamber blocks is part of one of said blocks and the other chamber block with a displacement appliance is displaceably secured onto said combination to at least accomplish the passage in between said chamber blocks for wafer transfer and to urge said stop wall sections of said chamber blocks against each other for wafer cleaning.

64. Apparatus as defined in Claim 63, comprising such means, that thereby said lower chamber block is part of said support block and said upper chamber block is displaceable in vertical direction.

65. Apparatus as defined in Claim 64, wherein thereby a thrust chamber is located for a vertical displacement of said central section of said lower chamber block to accomplish a whether or not open wafer cleaning position and said uoper chamber block is displaceable in vertical direction to accomplish wafer transfer and the sealed-off wafer cleaning position.

66. Apparatus as defined in Claim 64, wherein said displacement appliance is structured that way, that, as seen in direction of wafer transfer, the front end and/or the back end of said upper chamber is displaceable over a certain distance in vertical direction for the wafer transfer.

67. Apparatus as defined in Claim 66, comprising such means, that thereby transfer toward said cleaning chamber of a wafer to be cleaned takes place by means of displacing the arm of said transfer robot toward a position within the then opened chamber block arrangement centrically with regard to said chamber recess in said upper chamber block, by means of an accomplished tilted position of said upper block and subsequently the downward displacement of said block toward a horizontal position the wafer is brought within said recess and after the subsequent moving back of said robot arm from underneath the wafer said upper chamber block is further moved downward toward the sealed-off wafer cleaning position.

68. Apparatus as defined in Claim 67, comprising such means, that with an excentrically supplied wafer by means of a scissor action of the lower rim of the vertical sidewall of said chamber recess against the wafer edge said wafer is urged toward its centric position within said recess.

69. Apparatus as defined in Claim 67, comprising such means, that after the wafer cleaning said wafer still is urged against said upper chamber wall and in opened transfer position of said block and in the take-over position of the wafer support blade of said discharge robot the thrust upon said wafer is ended and said wafer by its own weight comes to rest upon said support blade for discharge thereof from said cleaning module.

70. Apparatus as defined in one of foregoing Claims, comprising such means, that for at least part of the wafer cleaning at least gaseous medium is used.

71. Apparatus as defined in Claim 70, comprising such means, that for at least part of the wafer cleaning a mixture of gaseous and medium in liquid phase is used.

72. Apparatus as defined in Claim 70, comprising such means, that for at least part of said cleaning a mixture of gaseous medium and another medium in gaseous or vapor phase is used.

73. Apparatus as defined in Claim 70, comprising such means, that for at least part of the cleaning a cleaning medium in vapor and liquid phase is used.

74. Apparatus as in Claim 70, comprising such means, that for the wafer cleaning jointly a supercritical fluid, as CO_2, is used in temporary liquid and/or gaseous phase.

75. Apparatus as defined in Claim 70, comprising such means, that thereby in said upper cleaning gap cleaning of the processing side of said wafer takes place by means of at least a cleaning medium and in said lower gap by means of at least gaseous medium at least a gaseous cushion for said wafer is maintained.

76. Apparatus as defined in Claim 70, comprising such means, that during the wafer cleaning the average height of the upper cleaning gap is that small, that its outer section has such considerable flow resistance for medium, that in said gap an almost individual cleaning takes place.

77. Apparatus as defined in Claim 76, comprising such means, that at least temporary by regulating the supply of the mediums toward both upper and lower gap the average height of said upper gap is smaller than that of said lower gap.

78. Apparatus as defined in Claim 70, comprising such means, that for the wafer cleaning an optimal use is made of the lagging effect of said reciprocating wafer.

79. Apparatus as defined in Claim 78, comprising such means, that during the expansion stroke said wafer,due to its relatively great mass, is lagging, with the accomplishment of bubbles within the liquid medium and a mini exploding action for removal of medium from the boundary layer immediately above said wafer and during the compression stroke the liquified medium in atomized condition jointly by means of the imploding action of said bubbles hefty affects said boundary layer and the wafer topography.

80. Apparatus as defined in Claim 70, comprising such means, that at least temporary during the wafer cleaning in said cleaning gaps a gradual replacement takes place of the finished-off cleaning medium by fresh, centrally supplied medium.

81. Apparatus as defined in Claim 80, comprising such means, that said replacement of medium thereby takes place at least temporarily continuous and at least almost uninterrupted.

82. Apparatus as defined in Claim 80, comprising such means, that during the cleaning of said wafer in at least the upper cleaning gap at least temporary a gradual replacement of the finished-off cleaning medium takes

place by fresh, centrally supplied medium of a following type.

83. Apparatus as defined in one of foregoing Claims, comprising such means, that thereby one of the following cleanings of said wafer takes place in whether or not combination:

cleaning under ultra-high pressure, overpressure, negative pressure or vacuum, with whether or not a gradual transfer of cleaning under overpressure toward cleaning under negative pressure and/or opposite.

84. Apparatus as defined in Claim 59, comprising the following:

a) at least one compartment for wafer cleaning, transfer and processing, whether or not combined with wafer storage and diagnose, located within an upper compartment;

b) a maintenance corridor, arranged in horizontal direction aside said compartment, with access for maintenance personnel;

c) a floor underneath said maintenance corridor, separating said upper compartment from a lower compartment;

d) above said compartments and said corridor a common top section as part of said upper compartment; and

e) means to maintain at least a column highly filtered inert gas in said compartments , said corridor and said top section ,

and wherein supply orifices for this inert gas are located above said floor.

85. Apparatus as defined in Claim 83, wherein thereby discharge orifices for this inert gas are located underneath the horizontal wafer transfer zone of the equipment sections, located in said upper compartment.

86. Apparatus as defined in Claim 84, wherein thereby said supply orifices are located above said wafer transfer zone.

87. Apparatus as defined in one of foregoing Claims, comprising such means, that thereby within said upper compartment above said corridor floor a column highly filtered air is maintained underneath said column inert gas.

88. Apparatus as defined in Claim 87, comprising such means, that said column air extends upward toward maximal said horizontal wafer transfer zone.

89. Apparatus as defined in Claim 87, wherein thereby a vertical separation wall is located in between said wafer transfer/processing/storage diagnostic compartments and said corridor sections, at least locally extending uoward from said corridor floor and beyond the separation level in between said columns air and inert gas.

90. Apparatus as defined in Claim 89, wherein thereby in said corridor

supply orifices for highly filtered air are located above said floor and underneath said separation level and discharge orifices for said air in said corridor are located in said floor.

91. Apparatus as defined in Claim 90, wherein thereby within said corridor discharge orifices for said inert gas are located above said separation level.

92. Apparatus as defined in Claim 89, comprising such means, that thereby said separation level in between said columns inert gas and air is located that far underneath the top of said separation wall, that during a whirling of the mediums within said corridor no air can enter said wafer transfer/processing/storage/diagnose compartment.

93. Apparatus as defined in one of foregoing Claims, comprising such means, that thereby at least jointly the maintenance of the equipment in said wafer transfer/processing/storage/diagnostic compartments takes place by means of maintenance personnel, temporary situated within a person enclosure.

94. Apparatus as defined in Claim 93, comprising such means, that said person enclosure, in which, by means of supply and discharge, a medium, comprising at least oxygen, is contained, at least temporary is located within said upper compartment and whereby its upper section over some distance in upward direction is removed from said separation level in between said column inert gas and said column air.

95. Apparatus as defined in Claim 94, wherein said enclosure at its lower side is open for access and is self supporting.

96. Apparatus as defined in Clain 95, wherein said enclosure comprises a rigid lower and upper section, which by means of a flexible joint are leak-free connected with each other to enable a bending of a person, situated within said enclosure.

97. Apparatus as defined in one of foregoing Claims, wherein said enclosure comprises two couple sections for mounting exchangeable arm enclosures thereon.

98. Apparatus as defined in Claim 97, wherein thereby the lower section of said enclosure is made heavier by means of a support member.

99. Apparatus as defined in Claim 98, wherein thereby in said support member a roll arrangement is located for displacement of said enclosure

100. Apparatus as defined in Claim 98, wherein said upper compartment comprises a cleaning arrangement for said enclosure.

101. Apparatus as defined in Claim 94, wherein said enclosure by means of tubings for supply and discharge of respiration air is connected with

couplings inside said corridor.

102, Apparatus as in one of foregoing Claims, wherein thereby in said horizontal separation wall manholes are located as person passage from said lower compartment and in return and such locally at said corridor.

103. Apparatus as defined in Claim 102, wherein in said lower compartment at said manhole a person elevator is located.

104. Apparatus as defined in Claim 103, comprising such means, that thereby the floor of said elevator in its upper position functions as corridor floor section.

105. Apparatus as defined in Claim 103, wherein thereby above said manhole said person enclosure is located in that way, that a person by means of said elevator is displaced upward toward his upper position within said enclosure and in return.

106. Apparatus as defined in one of foregoing Claims, wherein thereby in said upper compartment in said column inert gas at least one rack for storage of ultra cleaned components for the equipment, brought therein by said maintenance personnel, is located.

107. Apparatus as defined in Claim 89, wherein in said wafer transfer/processing/storage/diagnose compartments discharge orifices for inert gas are located underneath said wafer transfer zone and said orifices through a discharge duct are connected with a common discharge duct.

108. Apparatus as defined in Claim 107, wherein said discharge orifices are located immediately above said separation level in between said columns inert gas and air.

109. Apparatus as defined in one of foregoing Claims, wherein under at least one wafer transfer/processing compartment at least locally a horizontal separation wall is located and said discharge orifice for said inert gas is located in said separation wall.

110. Apparatus as defined in one of foregoing Claims, wherein thereby for maintaining a set separation level in said corridor a float switch is located for regulation of the supply and discharge of said air and whereby in said corridor said discharge orifices for said inert gas are located above said separation level.

111. Apparatus as defined in one of foregoing Claims, wherein, as in said wafer transfer/processing/storage/diagnostic compartment at the entrance of a wafer processing station a cleaning module is located, thereby behind said module a second cleaning module is located at least before a following wafer processing station.

112. Apparatus as defined in Claim 111, wherein, as behind a module,

wherein cleaning of said wafer takes place by means of supplied mediums in gaseous and liquid phase, a high vacuum station is located, with de-hydration bake of said wafer under an at least temporarily increased pressure.

113. Apparatus as defined in one of foregoing Claims, wherein thereby before a station, in which processing takes place under vacuum, a wafer cleaning module is located, with wafer cleaning by means of the combination of gaseous medium and a supercritical fluid.

114. Apparatus as defined in one of foregoing Claims, whereby in between vertical sidewalls of successive wafer transfer/processing compartments a branched corridor section is located, extending into a common corridor.

115. Apparatus as defined in Claim 114, wherein thereby in said main upper compartment on both sides of said common corridor as central corridor successive combinations of said wafer transfer/processing stations are located.

116. Apparatus as defined in Claim 115, wherein thereby in said upper compartment said wafer transfer/storage/diagnostic stations are located at the outside and in between the vertical sidewalls of said wafer transfer/processing stations branched sections of said central corridor extend toward said vertical separation walls aside said outer stations.

117. Apparatus as defined in Claim 116, wherein thereby at least two covered main upper compartments are located aside each other, with in between operator corridors of said operator room and said apparatus comprises such means, that wafer transfer between said upper compartments takes place through a common lower compartment and such whether or not in cassettes.

118. Apparatus as defined in Claim 115, wherein thereby wafer supply and discharge sections are located in a wafer processing station, and extending in downward direction from said horizontal wafer transfer zone.

119. Apparatus as defined in Claim 116, wherein thereby at the sidewall of said cover of said main upper compartment wafer diagnostic stations are located within a console section thereof.

120. Apparatus as defined in Claim 116, wherein thereby in said main upper compartment TV cameras are located for control and inspection of equipment, located therein, and the wafer transfer.

121. Method for apparatus for wafer transfer and processing, consisting of at least one wafer cleaning module, at least comprising:

a) a combination of lower chamber block and upper chamber block;

b) a cleaning chamber, located in between said blocks in at least one central recess, for cleaning a wafer;

c) in said block arrangement in lateral direction aside said chamber a discharge passage for the cleaning medium;

d) means for removal of said chamber blocks from each other for wafer transfer toward and from said cleaning chamber and displacing toward each other for wafer cleaning; and

e) a pulsator for during at least said wafer cleaning in said cleaning chamber by means of the reciprocation of a chamber wall under pulsating action, providing an at least temporary variation of the height of said cleaning chamber,

whereby during said wafer cleaning, with an at least temporary established medium discharge gap in between said chamber blocks from said cleaning chamber toward said discharge passage, a sealing-off system is established by means of at least gaseous medium.

122. Method as defined in Claim 121, wherein said discharge gap is accomplished by means of cooperating stop walls of said chamber blocks.

123. Method as defined in Claim 122, wherein thereby said medium discharge gap extends uninterruptedly in radial direction during part of said wafer cleaning.

124. Method as defined in one of foregoing Claims, wherein, as thereby said chamber blocks comprise in addition cooperating, in radial direction uninterrupted wall sections, extending in lateral direction outward from said discharge passage, during said wafer cleaning said combination of wall sections at least almost entirely seals off said discharge passage in lateral direction from the outer environment.

125. Method as defined in Claim 124, whereby in cleaning position of said chamber blocks by means of gaseous medium a sealing-off system is accomplished for said discharge passage in laterally outward direction.

126. Method as defined in Claim 124, whereby, as at said wall sections in between said blocks a gaseous lock compartment is located, extending in radial direction, gaseous medium, supplied into said compartment, prevents that cleaning medium, urged into said discharge passage, can escape therefrom in laterally outward direction in between said wall sections.

127. Method as defined in Claim 126, whereby, as said extension of said gaseous lock compartment extends in laterally outward direction toward the exterior of said chamber block arrangement, medium supply into said gaseous lock compartment for maintaining said gaseous lock takes place from the environment outside said chamber block arrangement.

128. Method as defined in Claim 126, whereby, as said gaseous lock compartment comprises an in vertical direction enlarged section, connected

with an individual supply of filtered gaseous medium, during joining of said stop wall sections of said chamber blocks the discharge of said gaseous medium from said compartment toward said discharge passage is limited.

129. Method as defined in Claim 128, whereby during the discharge of said cleaning medium the pressure in said compartment is higher than the pressure of the medium in said discharge passage.

130. Method as defined in one of foregoing Claims, whereby in joined position of said stop wall sections of said chamber blocks the following medium discharge gaps are accomplished:

a) outward said discharge passage a discharge gap for supply of gaseous medium toward said discharge passage;

b) at least temporary in between said cleaning chamber and said discharge passage an in radial direction uninterrupted discharge gap for discharge of cleaning medium from said cleaning chamber; and

c) outward said gaseous lock compartment a micro gap in between said wall sections, with possibly a local contact between said sections.

131. Method as defined in one of foregoing Claims, whereby, as:

a) with a chamber block a central chamber block section, extending in lateral direction beyond said cleaning chamber, by means of a cylindrical membrane section is connected with an outer mounting section of said block;

b) said discharge passage is located in laterally outward direction over some distance away from said membrane section;

c) a cover is pressure-tight secured against said outer block section, with the creation of a pulsator chamber; and

d) in said pulsator chamber a pulsator arrangement is located for a pulsating reciprocation of said central chamber block section, jointly by means of thrust medium, situated within said pulsator chamber, said sealing-off system for said cleaning chamber is accomplished.

132. Method as defined in Claim 131, whereby, as said membrane section comprises a cylindrical sealing-off wall section, corresponding with a contra sealing-off wall section of the other chamber block, and said discharge gap extends inward from said discharge passage toward at least said sealing-off wall section, by means of a resulting thrust of at least said thrust mediums in said pulsator chamber and said discharge gap, said membrane seáling-off wall section is temporarily urged onto said contra sealing-off wall, with an at least almost total sealing off of the discharge of said cleaning medium from said cleaning chamber.

133. Method as defined in Claim 132, whereby, as said sealing-off wall

section of said membrane section is located beyond the center of said membrane section at the side of said discharge passage, at least temporary during the wafer cleaning, with whether or not medium discharge taking place from said cleaning chamber, a considerable positive difference is maintained between the pressure in said pulsator chamber and said discharge passage.

134. Method as defined in Claim 132, whereby, with a certain pressure in said pulsator chamber by means of supply of medium into said cleaning gaps therein such pressure build-up takes place, that said sealing-off wall section of said membrane section is temporary and at least locally lifted from said contra sealing-off wall section of the other chamber block, with temporary the creation of an at least locally uninterrupted mini discharge gap from said cleaning chamber toward said discharge passage.

135. Method as defined in Claim 134, whereby, as in said pulsator chamber a stop wall is located and said central chamber block section comprises a corresponding stop wall section, during the wafer cleaning during the limitation of the maximal volume of said cleaning chamber by means of said stop walls , it is prevented, that the reciprocating pulsations of said central block section is nullified and for that purpose the thrust medium, located in between said stop walls , functions as damper.

136. Method as defined in Claim 135, whereby, as for discharge of cleaning medium with an at least almost constant pressure in said discharge passage temporarily the pressure in said cleaning chamber is reduced, thereby temporary said stop wall section of said central chamber block section,with in between situated damping medium,is urged against said contra wall under overpressure.

137. Method as defined in one of foregoing Claims, whereby, as said membrane section comprises a sealing-off section, a first flexible membrane section in between said sealing-off section and said pulsating central chamber block section and a second flexible membrane section in between said sealing-off section and said outer chamber block section, in said pulsator chamber a stop wall is located and said sealing-off section comprises a contra stop wall, therewith the displacement of said sealing-off section from its sealing-off position is limited.

138. Method as defined in Claim 137, whereby, as said cylindrical sealing-off section at least locally over some distance is flat, therewith in open position of said sealing-off section a discharge gap with a great flow resistance is accomplished.

139. Method as defined in Claim 137, whereby in the stop position of

said stop wall of said sealing-off section against said corresponding stop wall in said pulsator chamber the height of the discharge gap section, extending from said cleaning chamber toward underneath said first membrane section,is that large, that the pulsating reciprocation of said central block section maximal to a small extent is reduced by means of the medium within said discharge gap section.

140. Method as defined in Claim 137, whereby, as said second flexible membrane section comprises a second sealing-off wall section, displaceable in vertical direction, and corresponding with a sealing-off wall section tion of the other chamber block, up to a certain pressure build-up in said cleaning chamber in said pass-through position of said first sealing-off section said second sealing-off section still is urged against said corresponding section of the other chamber block and above said certain pressure build-up in said cleaning chamber with regard to the pressure of the medium in said pulsator chamber and said discharge passage said second sealing-off section is lifted from said corresponding sealing-off section, with the accomplishment of medium discharge.

141. Method as defined in one of foregoing Claims, whereby, as onto said central upper chamber block section at least one pulsator is secured, the upper section of said pulsator is a damper wall, within said pulsator chamber a corresponding damper wall is located and the distance in between is that limited, that in combination with a considerable area thereof the vibration of said upper pulsator section is damped, thereby the height of the gap in between said damper walls is such, that with a maximal attainable volume of said cleaning chamber the upward displacements of said upper section of said pulsator is damped to such extent, that said damper functions as compressible stop.

142. Method as defined in one of foregoing Claims, whereby,as opening and sealing-off of the medium pass-through in said discharge gap at said membrane sealing-off section mainly takes place by means of accomplished differences in pressure of the medium, acting on both sides of said membrane section,within the narrow discharge gap sections, extending outward from said cleaning chamber toward said sealing-off section of said membrane section, in open condition thereof by means of expelled medium such great, flow resistance is created, that thereby the reduction in pressure in said discharge gap at said membrane section, combined with the pressure in said pulsator chamber,accomplish at least a narrowing of the pass-through gap at said sealing-off section, and depending on the supply of medium into said cleaning chamber said micro pass-through gap at said sealing-off

section at least temporary is opened to a more or less extent.

143. Method as defined in Claim 142, whereby during the wafer cleaning the pressure in said discharge gap is approximately the same as the average pressure in said cleaning chamber and during the regulation of the pressure of the medium in said pulsator chamber for said wafer cleaning or medium discharge the pressure in said discharge passage is adapted accordingly.

144. Method as defined in one of foregoing Claims, whereby by means of a piezo transducer arrangement said central chamber block section is reciprocated at a high frequency.

145. Method as defined in one of foregoing Claims, whereby by means of an hydraulic pulsator said central chamber block section is reciprocated at low frequency.

146. Method as defined in Claim 145, whereby a regulatable amount of medium is supplied and discharged into and from said pulsator chamber.

147. Method as defined in one of foregoing Claims, whereby a series of wafer cleaning modules and wafer processing modules are arranged within a compartment, wherein at least jointly an inert gaseous medium is situated and the interfacing wafer transfer takes place by means of wafer transfer robots.

148. Method as defined in Claim 147, whereby by means of a cover said compartment is separated from an adjacent operator room, said cover extends in downward direction toward at least beyond the horizontal wafer transfer zone of said robots, underneath said upper compartment a lower compartment extends, comprising air, and maintenance personnel for at least part thereof enters said upper compartment for maintenance of equipment and returns therefrom.

149. Method as defined in one of foregoing Claims, whereby, as in said upper chamber block said central block section as reciprocable upper wall of said cleaning chamber by means of a cylindrical membrane section in outward direction is connected with a mounting section, and in said lower chamber block a second central block section is located, extending over some distance in laterally outward direction beyond said discharge passage, and by means of a cylindrical membrane section in laterally outward direction is connected with an in radial direction uninterrupted mounting section, to accomplish a medium discharge from said cleaning chamber the central lower block section is displaced downward over less than 0,1 mm from from said upper chamber block toward a stop arrangement.

150. Method as defined in one of foregoing Claims, whereby, as said module in addition comprises a combination of support block and cover block,

secured to each other and one of said chamber blocks is part of said combination, the other chamber block by means of a displacement appliance , located in between, is displaceable with regard to said combination to at least accomplish the passage in between said chamber blocks for wafer transfer and to urge said stop wall sections of said chamber blocks against each other for wafer cleaning.

151. Method as defined in Claim 150, whereby, as said lower chamber block is part of said support block, said upper chamber block is displaceable in vertical direction and functions as pulsator block, containing the reciprocable central section.

152. Method as defined in Claim 151,whereby, as a thrust chamber is established in the lower section of said support block, by means of discharge of medium from said thrust chamber the central section of said lower chamber block is displaced downward to provide a more or less open medium discharge gap.

153. Method as in Claim 151, whereby, as said displacement appliance is an arrangement of thrust blocks and,as seen in direction of wafer transfer, both front and back end of said upper chamber block are displaced over a certain distance for wafer transfer and back for wafer cleaning, transfer of a wafer, to be cleaned, into said cleaning chamber takes place by means of a robot arm, said wafer is brought toward a centric position thereof with regard to said chamber recess in said upper chamber block,and by means of an accomplished tilted position of said upper chamber block, together with a subsequent downward displacement of said block toward an horizontal position thereof,said wafer is urged into said recess and subsequently, after moving back of said robot arm from underneath said wafer, said block is moved downward toward its wafer cleaning position.

154. Method as defined in Claim 153, whereby an excentrically supplied wafer by means of a scissor action of the lower rim of the vertical sidewall of said chamber recess against the wafer edge said wafer is urged toward its centric position within said recess.

155. Method as defined in Claim 153, whereby after cleaning of said wafer it is still urged against said upper chamber wall and in opened transfer position of said upper block, combined with the take-over position.of the wafer support blade of said discharge robot the thrust upon said wafer is ended and said wafer by its own weight comes to rest upon said support blade for discharge thereof from said cleaning module.

156. Method as defined in one of foregoing Claims, whereby for at least

part of the cleaning of said wafer at least gaseous medium is used.

157. Method as defined in Claim 156, whereby for at least part of the cleaning of said wafer a mixture of gaseous medium and a fluid in liquid phase is used.

158. Method as defined in Claim 156, whereby for at least part of the cleaning of said wafer a mixture of gaseous medium and a fluid in vapor phase is used.

159. Method as defined in Claim 158, whereby for at least part of said wafer cleaning a cleaning fluid in gaseous and liquid phase is used.

160. Method as defined in Claim 157, whereby a supercritical fluid, as CO_2, is used in temporary liquid phase and/or gaseous phase.

161. Method as defined in Claim 156, whereby in said upper cleaning gap cleaning of the processing side of said wafer takes place by means of at least a cleaning fluid and in said lower gap by means of at least gaseous medium at least a gaseous cushion for said wafer is maintained.

162. Method as defined in Claim 156, whereby at least temporary by means of regulating the supply of the mediums toward both upper and lower gap the average height of said upper gap is smaller than that of said lower gap.

163. Method as defined in Claim 156, whereby during the expansion stroke said wafer, due to its relatively great mass is lagging , with the creation of bubbles within the liquid medium and a mini exploding action for removal of medium from the boundary layer immediately above said wafer and during the compression stroke the liquified medium in atomized condition jointly by means of the imploding action of said bubbles hefty affects said boundary layer and the valleys within the wafer topography.

164. Method as defined in Claim 156, whereby at least temporary during said wafer cleaning in said cleaning gaps a gradual replacement takes place of the finished-off cleaning medium by fresh, centrally supplied medium.

165. Method as defined in Claim 164, whereby during said wafer cleaning in at least the upper cleaning gap at least temporary a gradual replacement of the finished-off cleaning medium takes place by fresh, centrally supplied medium of a following type.

166. Method as defined in one of foregoing Claims, whereby one of the following cleanings of said wafer takes place in whether or not a combination:

cleaning under ultra-high pressure, overpressure, negative pressure or vacuum, with whether or not a gradual transfer of cleaning under overpressure toward cleaning under negative pressure and/or opposite.

167. Method as defined in Claim 166, whereby, as said apparatus in addition comprises the following:

a) at least one compartment for wafer cleaning, transfer and processing, whether or not combined with wafer storage and diagnose, located within an upper compartment;

b) a maintenance corridor, arranged in horizontal direction aside said compartment, with access for maintenance personnel;

c) a floor underneath said maintenance corridor, separating said upper compartment from a lower compartment

d) above said compartments and said corridor a common top section as part of said upper compartment; and

e) means to maintain at least a column highly filtered inert gas in said compartments, said corridor and said top section,

supply of said inert gas takes place above said floor and discharge thereof takes place underneath the horizontal wafer transfer zone of the equipment sections, located in said upper compartment.

168. Method as defined in Claim 167, whereby the supply of said inert gas takes place above said wafer transfer zone.

169. Method as defined in one of foregoing Claims, whereby within said upper compartment above said corridor floor a column highly filtered air is maintained underneath said column inert gas.

170. Method as defined in Claim 169, whereby said column air extends upward toward maximal said horizontal wafer transfer zone.

171. Method as defined in Claim 169, whereby, as a vertical separation wall is located in between said wafer transfer/processing/storage/diagnostic compartments and said corridor, at least extending upward from said corridor floor toward beyond the separation level in between said columns air and inert gas, the supply of highly filtered air into said corridor takes place below said separation level and the discharge of said air at least jointly takes place through apertures within said floor and the discharge of said inert gas takes place above said separation level.

172. Method as defined in one of foregoing Claims, whereby at least jointly the maintenance of said equipment sections within said wafer transfer/processing/storage/diagnostic compartments takes place by means of maintenance personnel, temporery situated within a person enclosure.

173. Method as defined in Claim 172, whereby said enclosure at least temporary is situated within said upper compartment, its upper section extends upward over some distance away from said separation level between air and inert gas, its lower end is open for access and during maintenance

with a person situated within said enclosure, medium, at least containing oxygen, is supplied into said enclosure, with discharge thereof underneath said separation level.

174. Method as defined in Claim 173, whereby by means of a roll arrangement a person, situated within said enclosure, displaces said enclosure over said corridor floor.

175. Method as defined in Claim 173, whereby said supply and discharge of said respiration medium takes place through tubings, connected with a coupling within said corridor.

176. Method as defined in one of foregoing Claims, whereby, as in said horizontal separation floor manholes are located for displacement of persons from said lower compartment toward and from said corridor, and in said lower compartment at said manhole a person elevator is located, by means of said elevator a person is moved upward toward his top position within said enclosure, with the floor of said elevator in its upper position functioning as corridor floor, and in return.

177. Method as defined in one of foregoing Claims, whereby, as in said upper compartment in said column inert gas at least one rack for storage of ultra cleaned components for said equipment sections, brought therein by said personnel, is located, said maintenance at least jointly takes place by means of said components.

178. Method as defined in Claim 171, whereby, as underneath at least one wafer transfer/processing compartment at least locally an horizontal separation wall is located, thereby at that place discharge of said inert gas takes place through a discharge passage in said separation wall.

179. Method as defined in Claim 171, whereby the regulation of the supply and discharge of at least said air for maintaining a set height of said separation level in this corridor takes place by means of a float switch, with its float floating on said column air.

180. Method as defined in one of foregoing Claims, whereby, as cleaning of said wafer in a module takes place by means of supplied liquid medium, as de-ionized water, degassing of said wafer takes place in a high vacuum station under an at least temporarily increased temperature.

181. Method as defined in one of foregoing Claims, whereby before a station, in which processing takes place under vacuum, in a wafer cleaning module the cleaning of said wafer takes place by means of gaseous and/or supercritical fluid, as CO_2.

182. Method as defined in one of foregoing Claims, whereby, as in said upper compartment said wafer transfer/storage/diagnostic stations are located

at the outside and in between the vertical sidewalls of said wafer transfer/processing stations branched sections of said central corridor extend toward said vertical separation walls aside said outer stations, maintenance of said stations at least jointly takes place from said branched corridor sections.

183. Method as defined in Claim 182, whereby, as at least two covered upper compartments are located aside each other, with in between a corridor of said operator room , wafer transfer between said upper compartments takes place through a common lower compartment and such whether or not in cassettes.

184. Method as defined in Claim 182, whereby, as a wafer processing station extends in downward direction from said horizontal wafer transfer zone, vertical wafer transfer and such whether or not in cassettes, takes place from and toward wafer supply and discharge sections at said wafer transfer zone.

185. Method as defined in Claim 182, whereby, as at the sidewall of said cover of said upoer compartment wafer diagnostic stations are located within a console section thereof, wafer diagnose takes place from said operator room.

186. Method as defined in Claim 182, whereby, as in said upper compartment TV cameras are located for control and inspection of equipment, located therein, together with said wafer transfer, by means of screens, located in said operator room, the pictures, whether or not in succession, are observed by an operator.

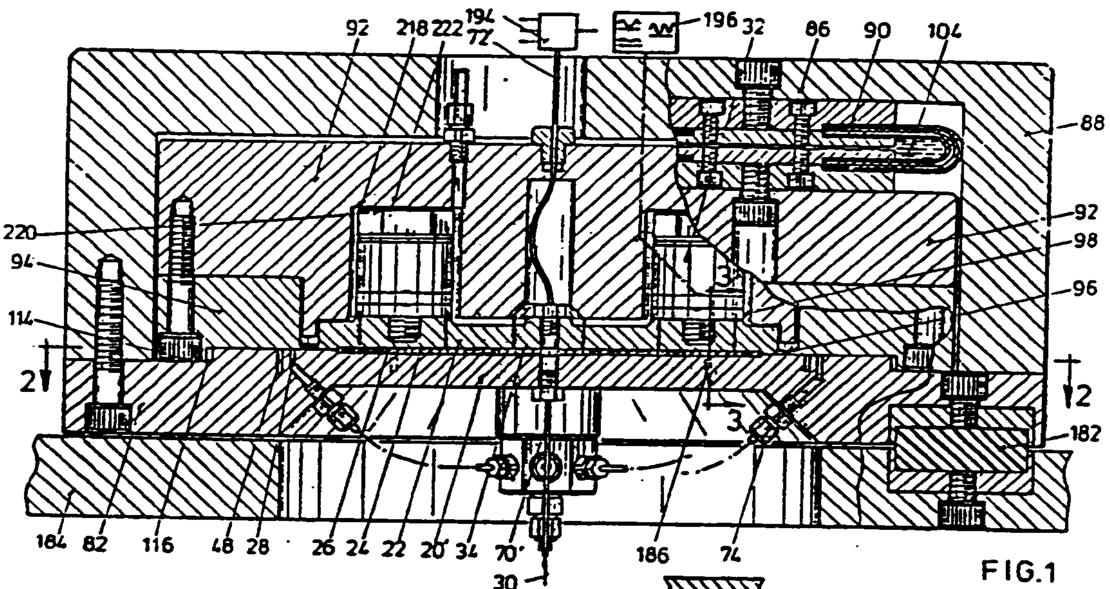


FIG.1

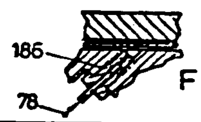


FIG.3

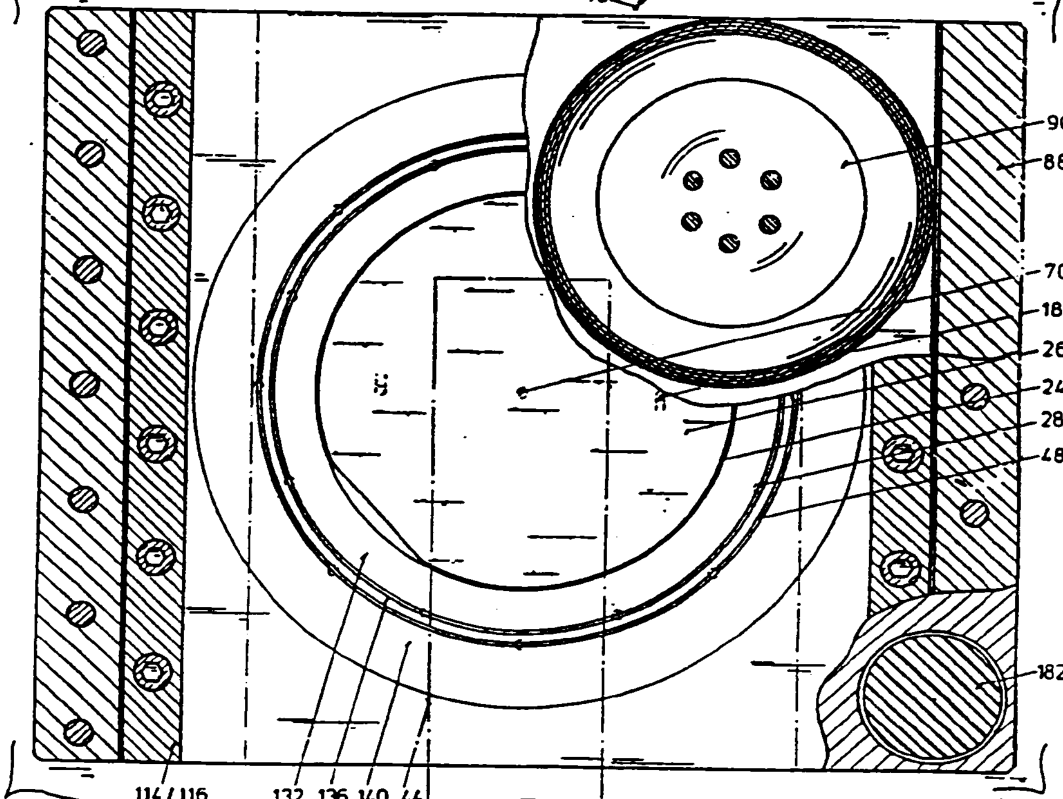
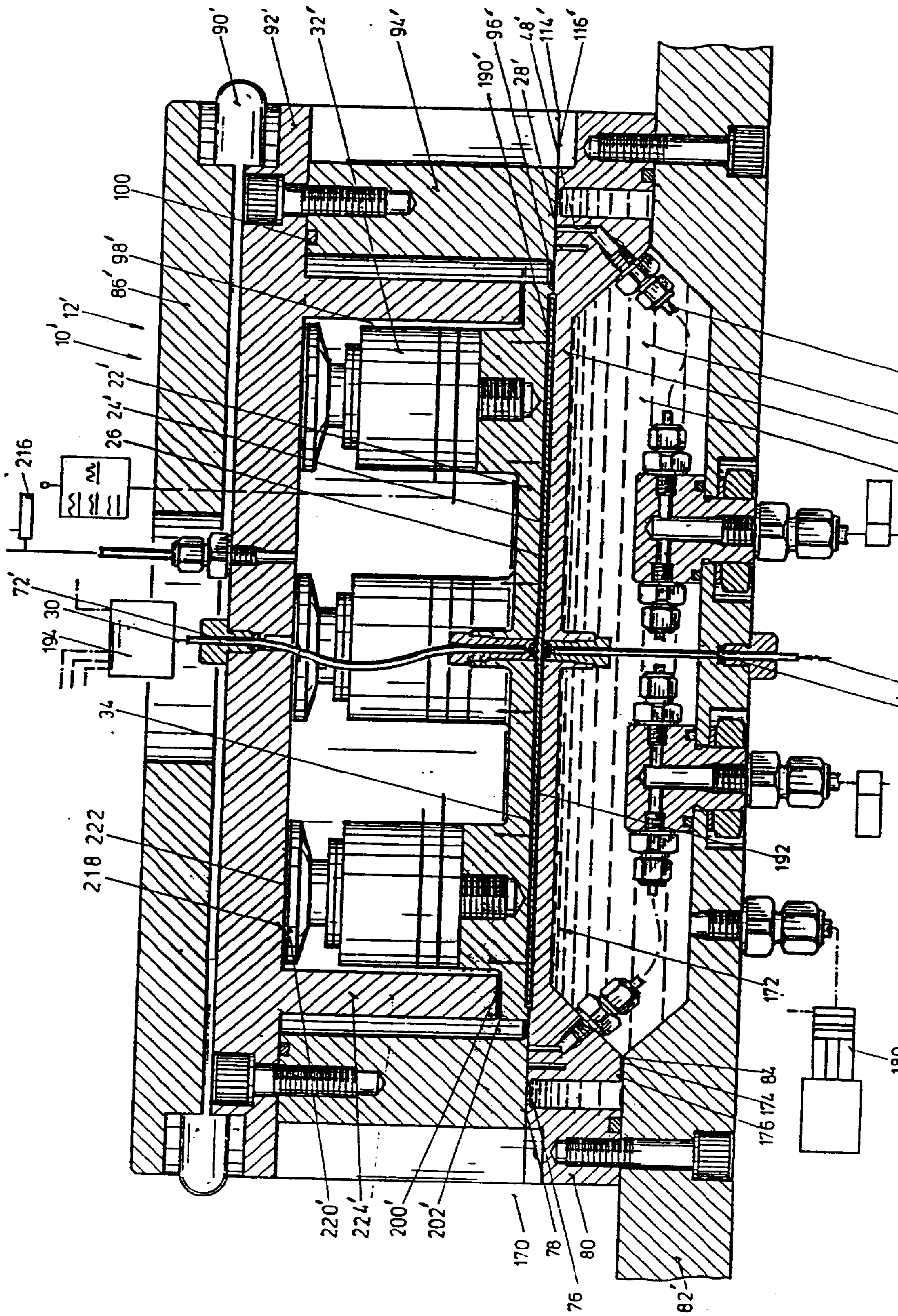


FIG.2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174
176

FIG. 4

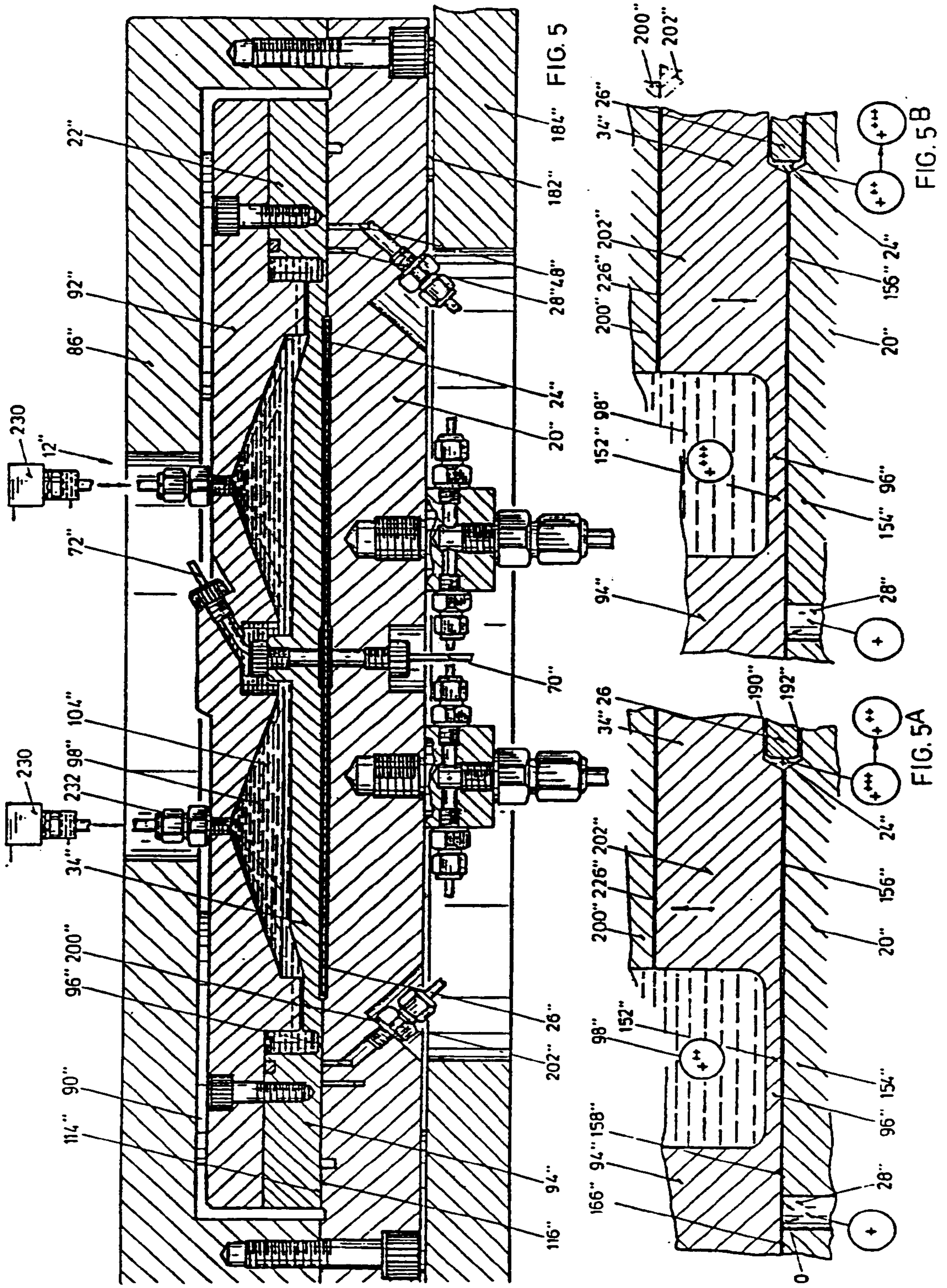


FIG. 5

FIG. 5A

FIG. 5B

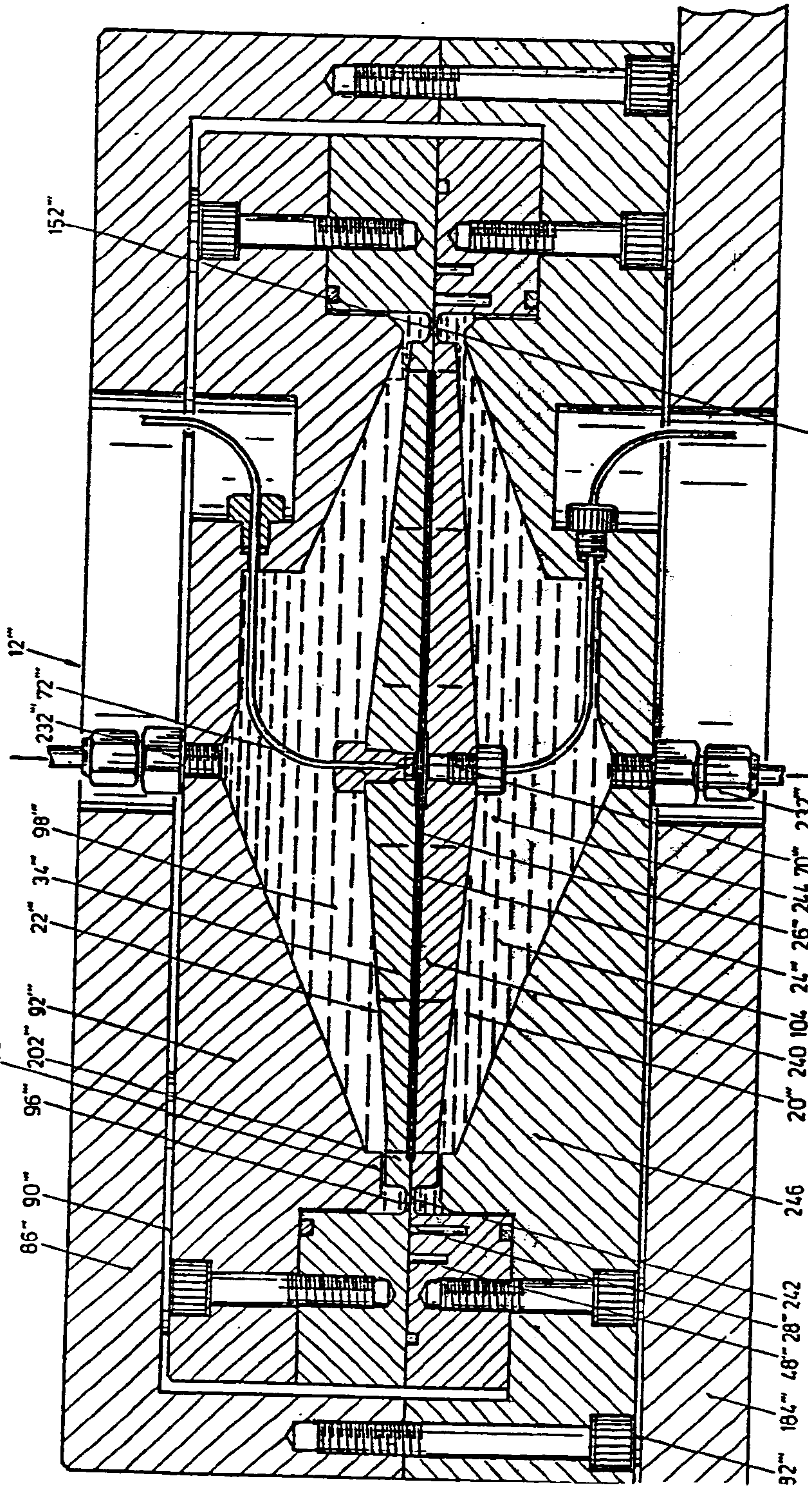


FIG.6

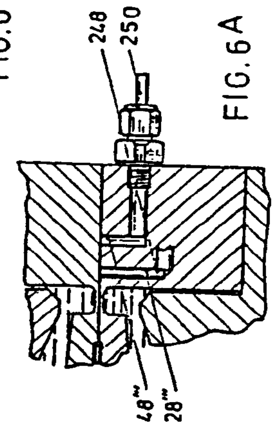


FIG.6A

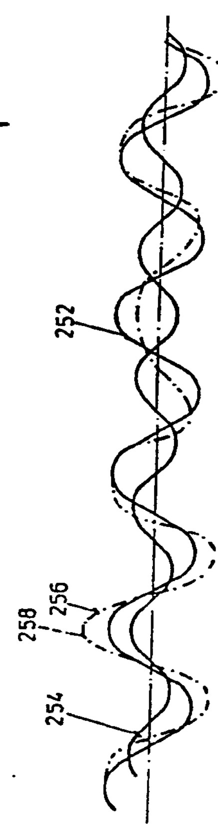


FIG.6B

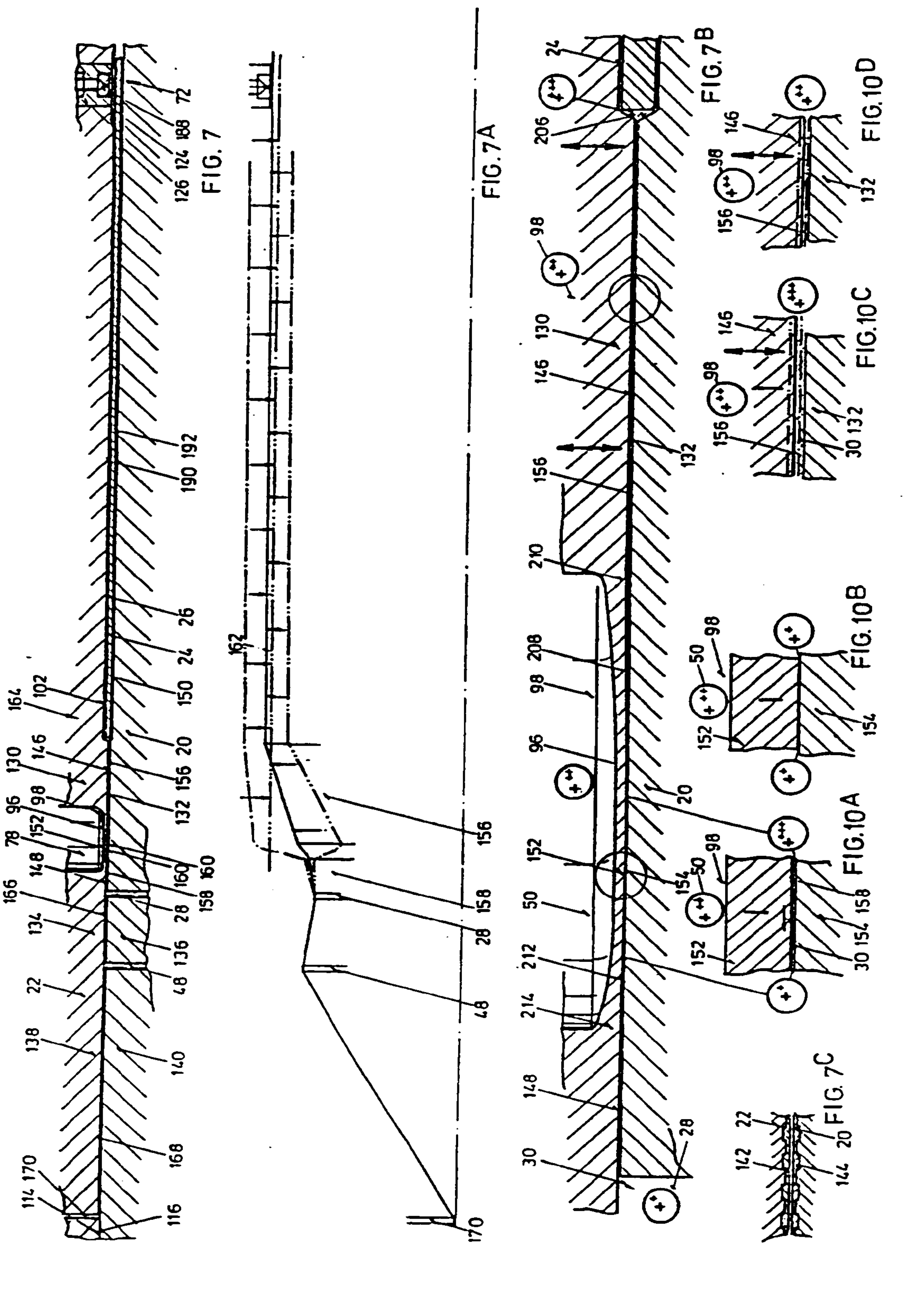


FIG. 7
FIG. 7A
FIG. 7B
FIG. 7C
FIG. 10A
FIG. 10B
FIG. 10C
FIG. 10D

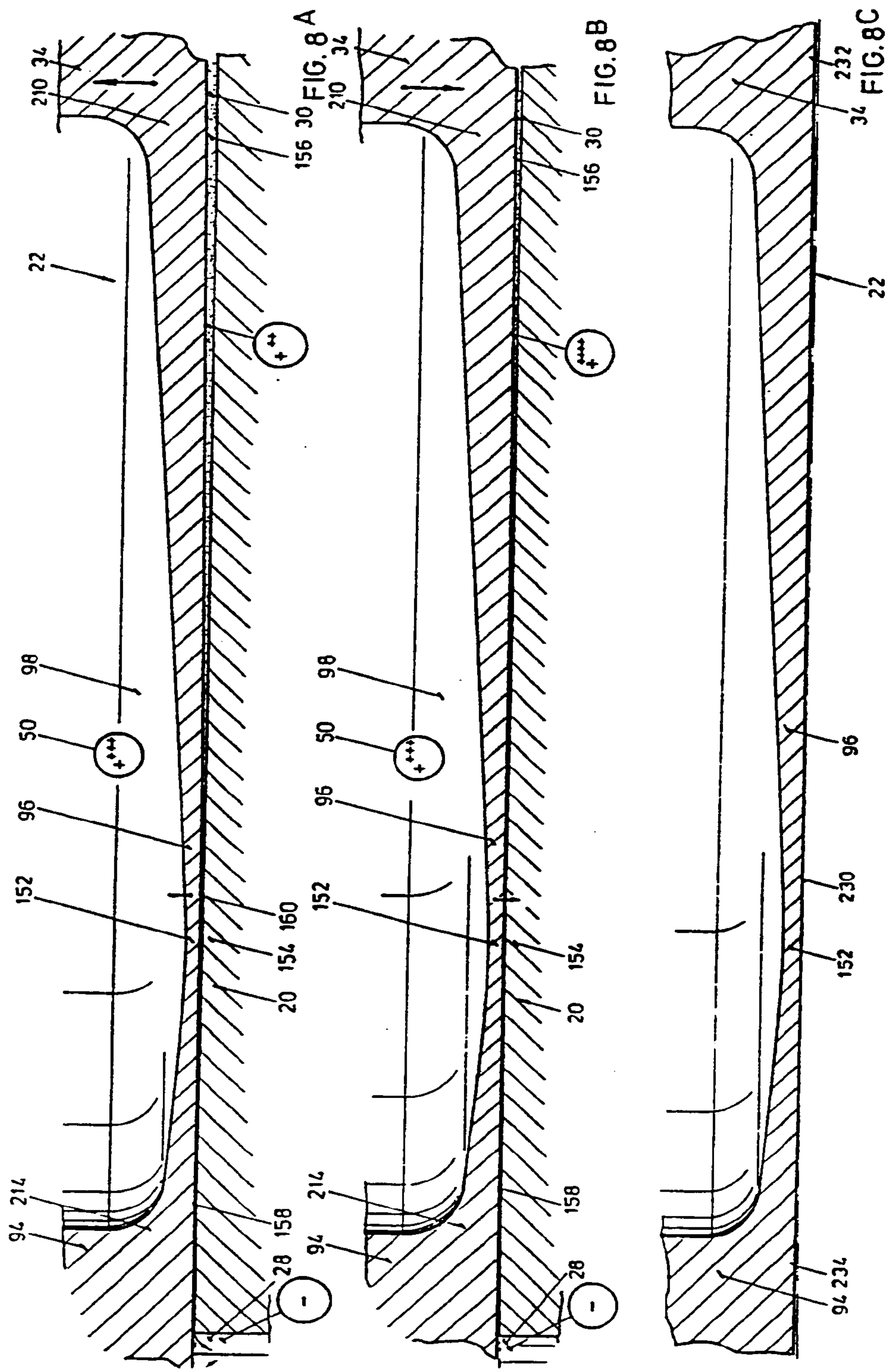


FIG. 8A

FIG. 8B

FIG. 8C

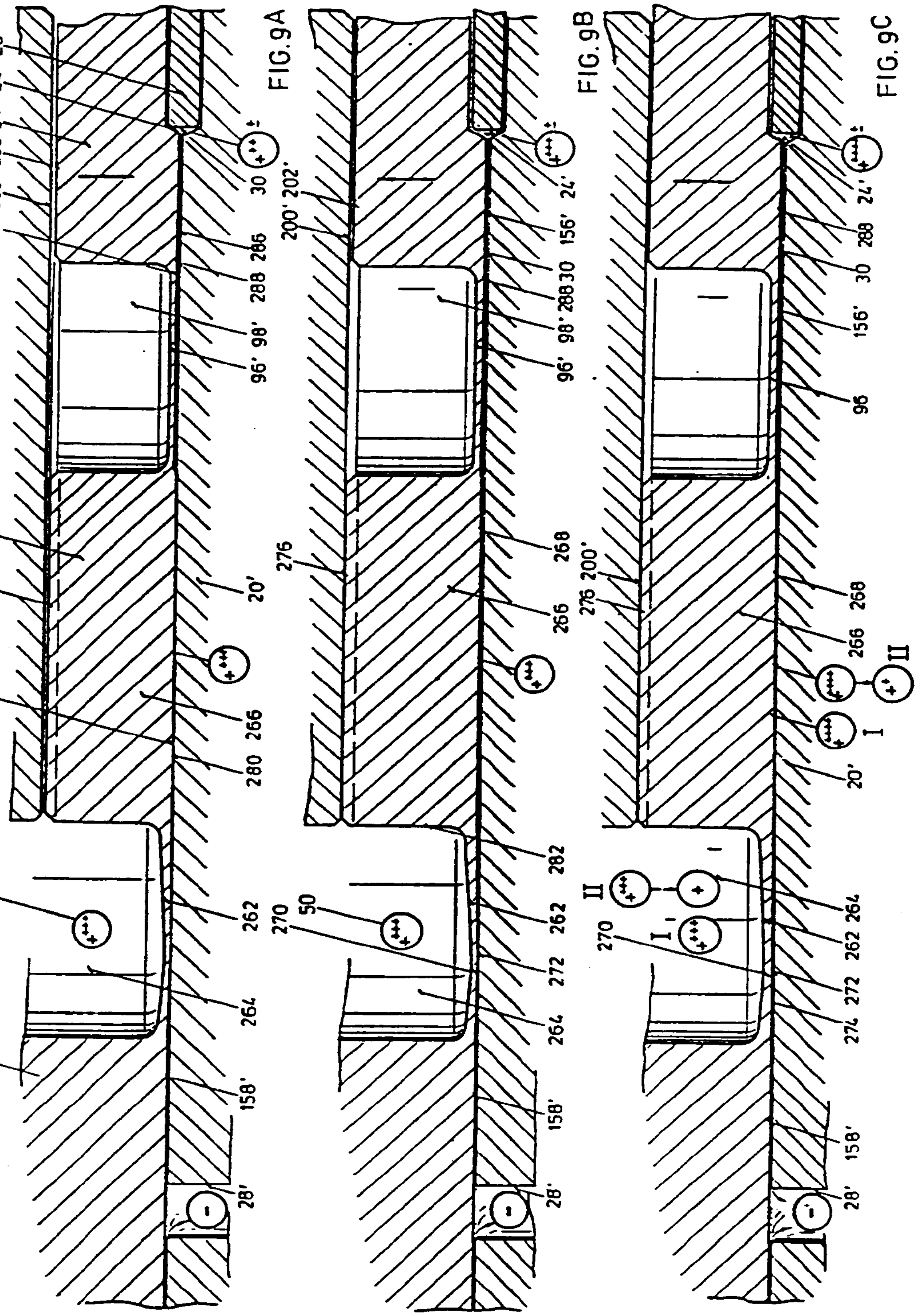


FIG.9A
FIG.9B
FIG.9C

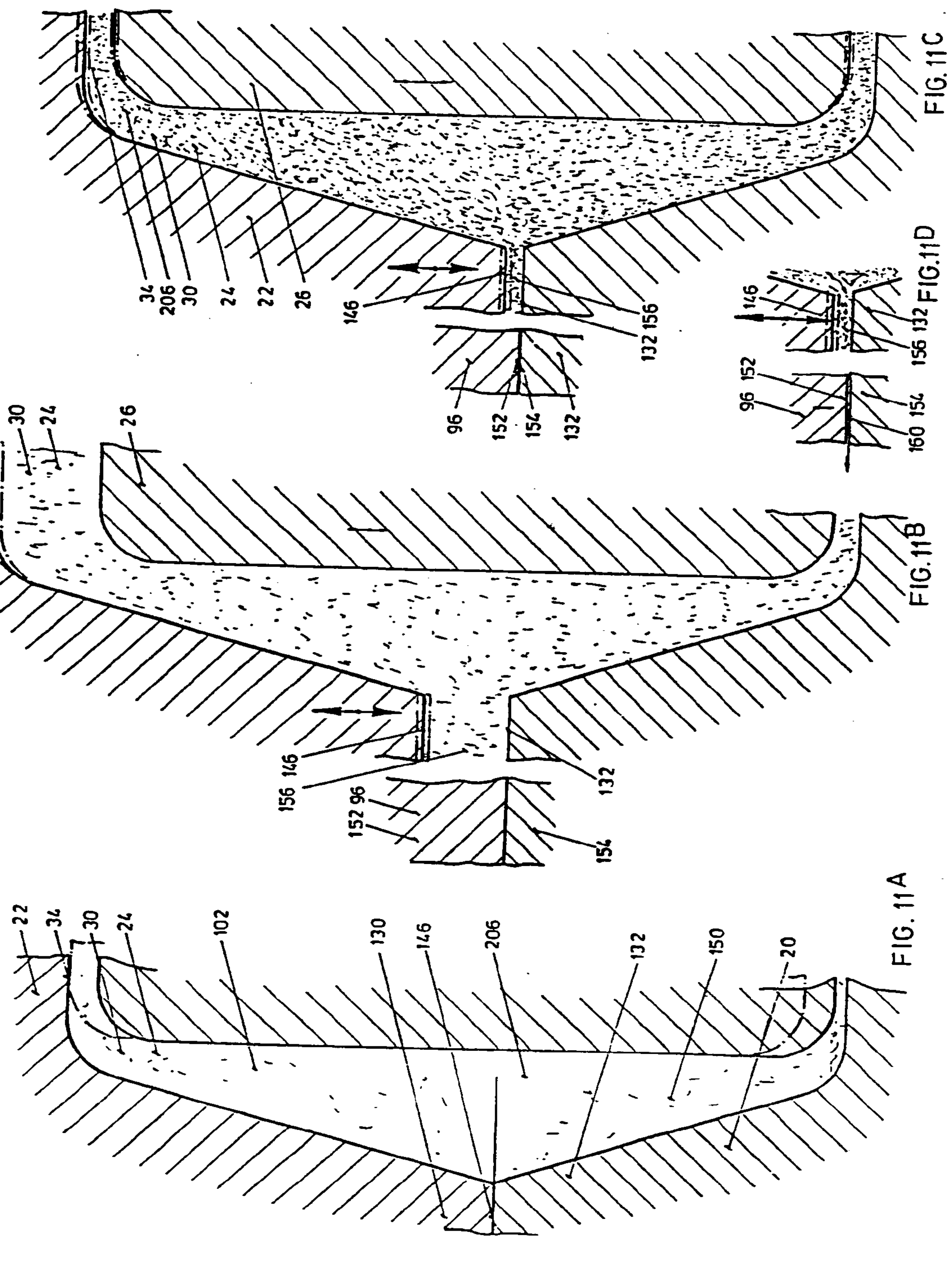


FIG. 11C

FIG. 11D

FIG. 11B

FIG. 11A

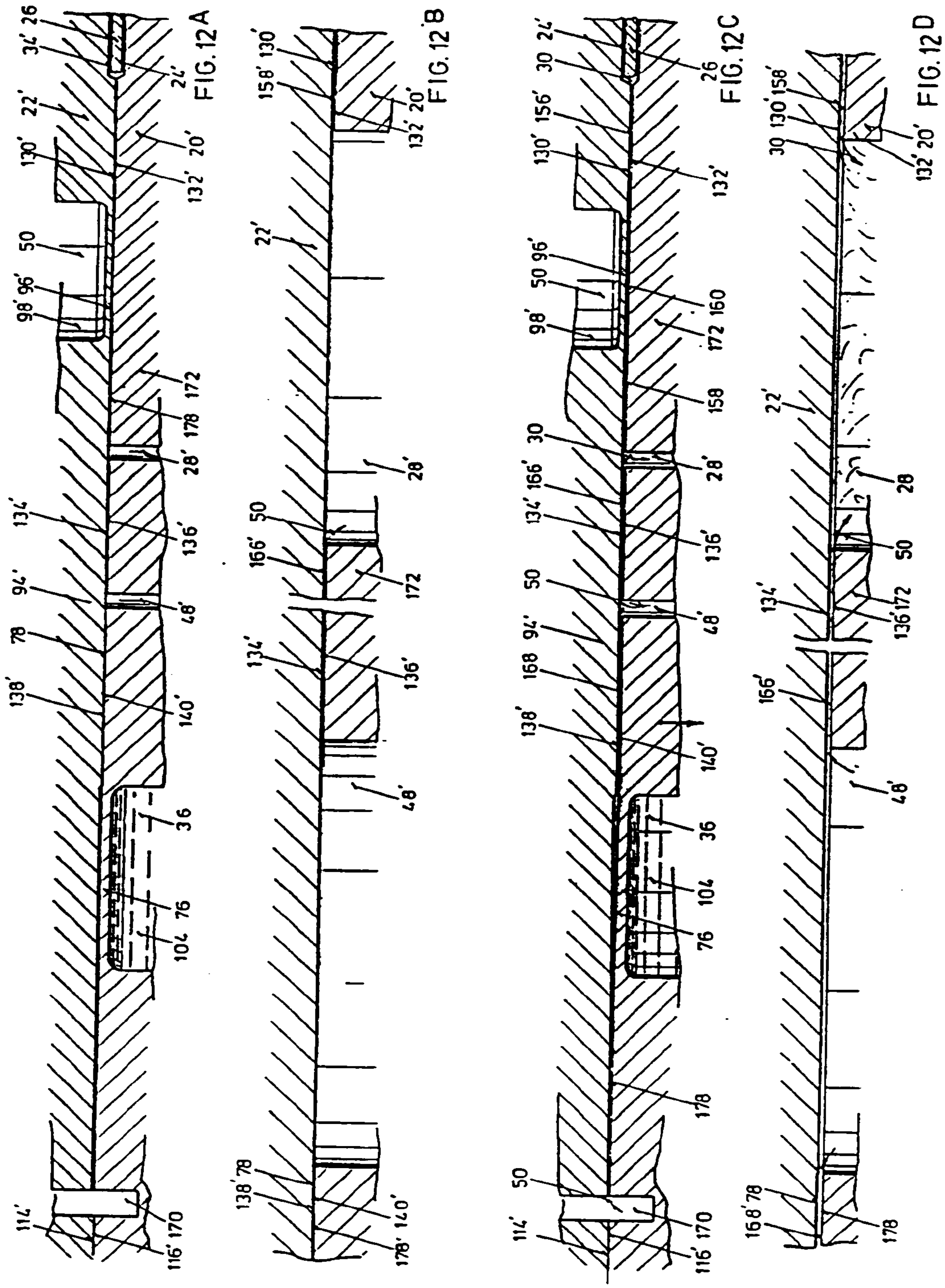


FIG. 12A FIG. 12B FIG. 12C FIG. 12D

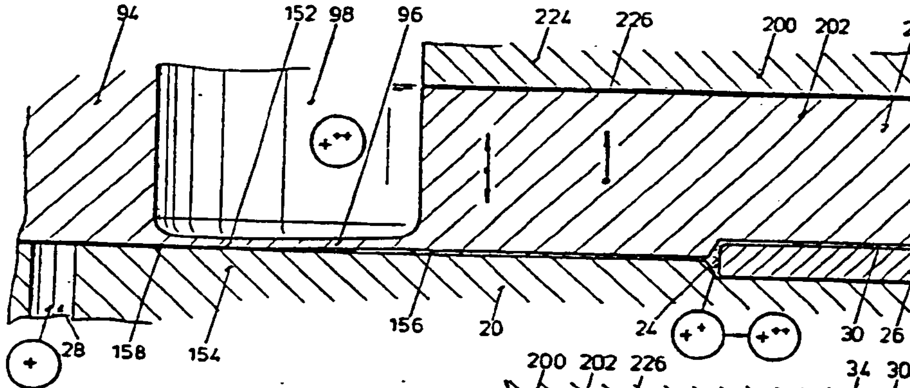


FIG.13A

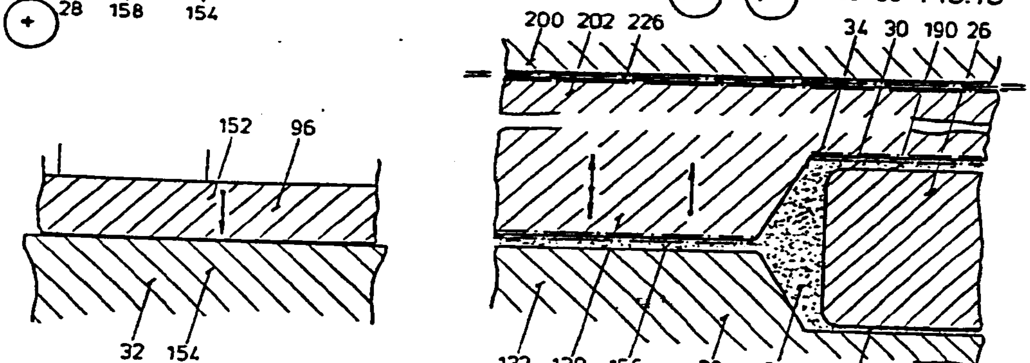


FIG.13B

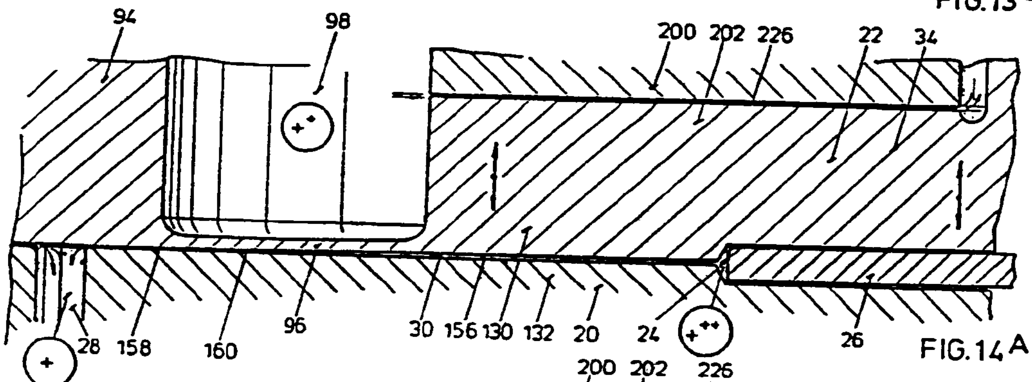


FIG.14A

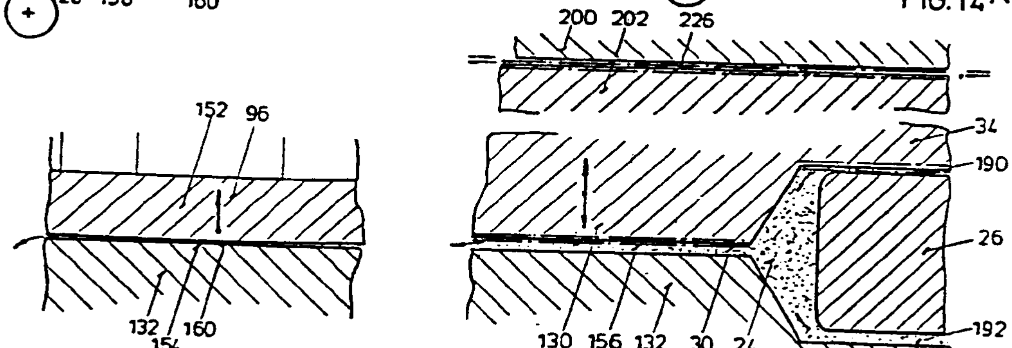


FIG.14B

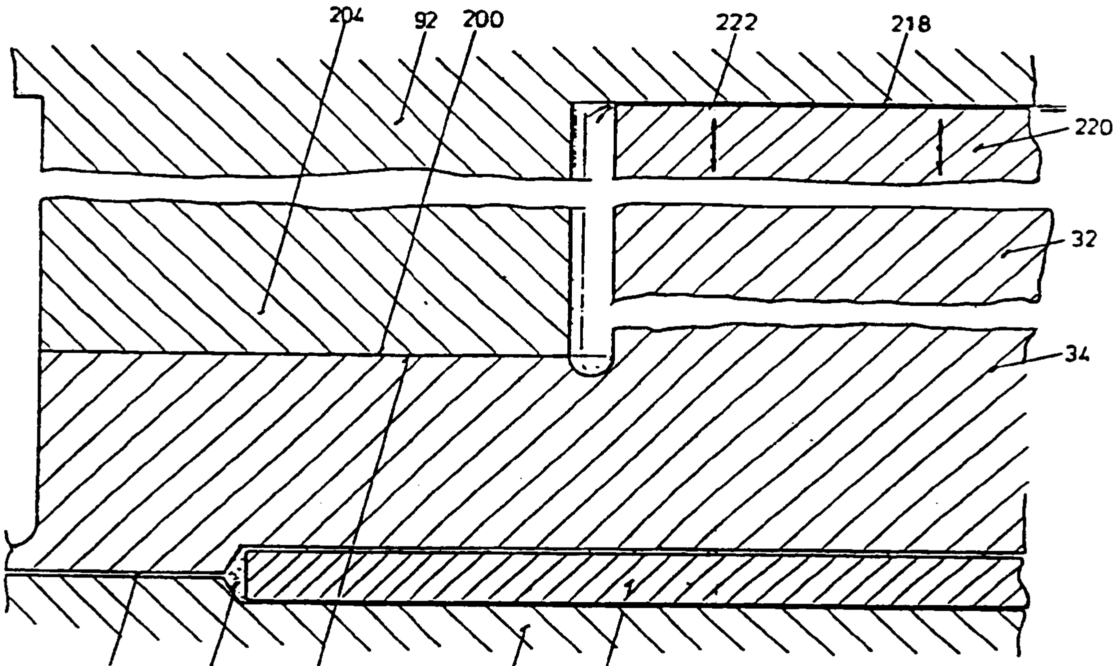


FIG.15

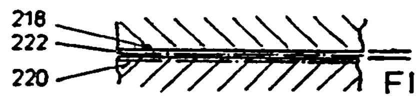


FIG.16B

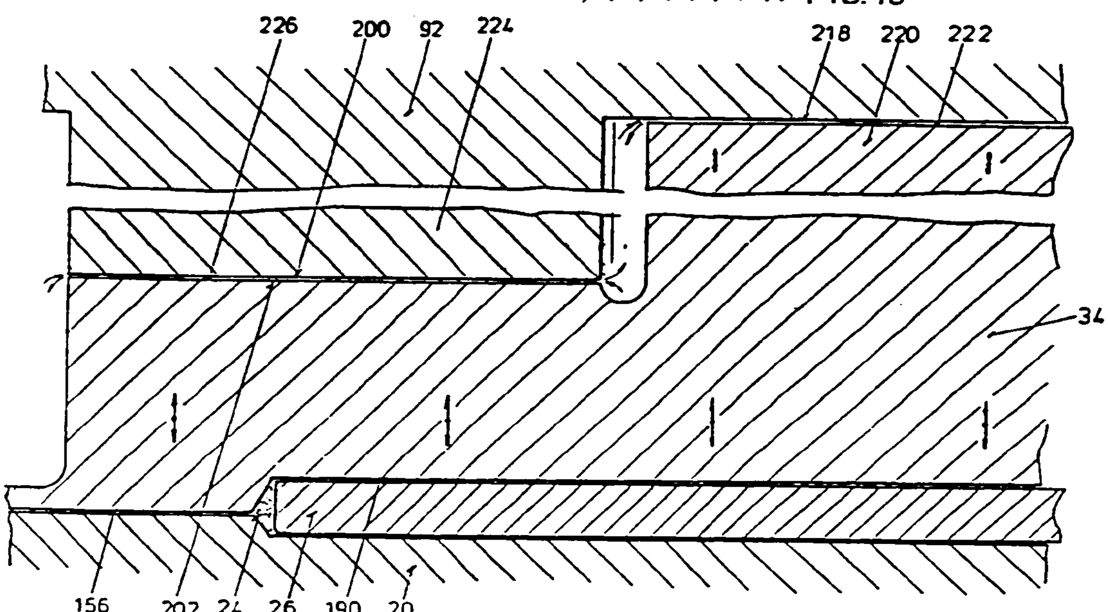


FIG.16A

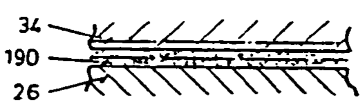


FIG.16C

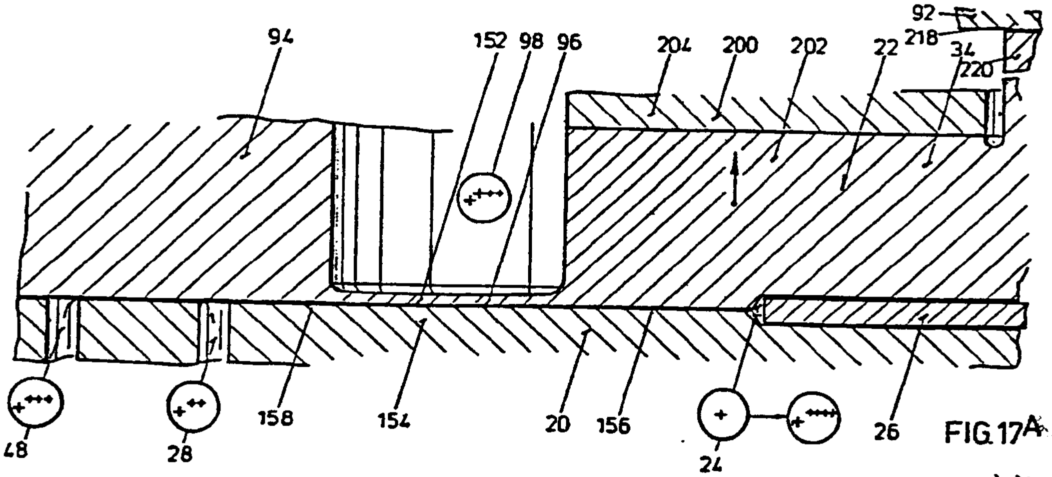


FIG.17A

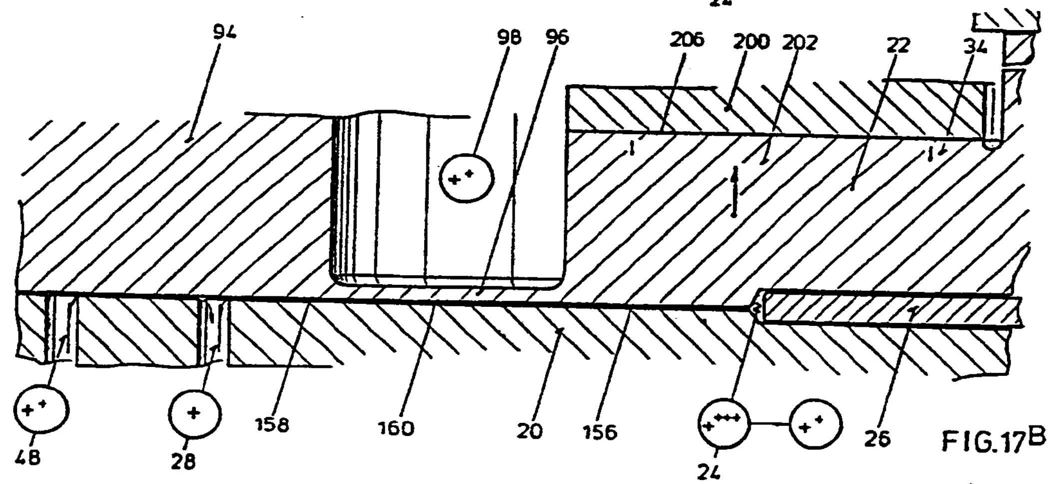


FIG.17B

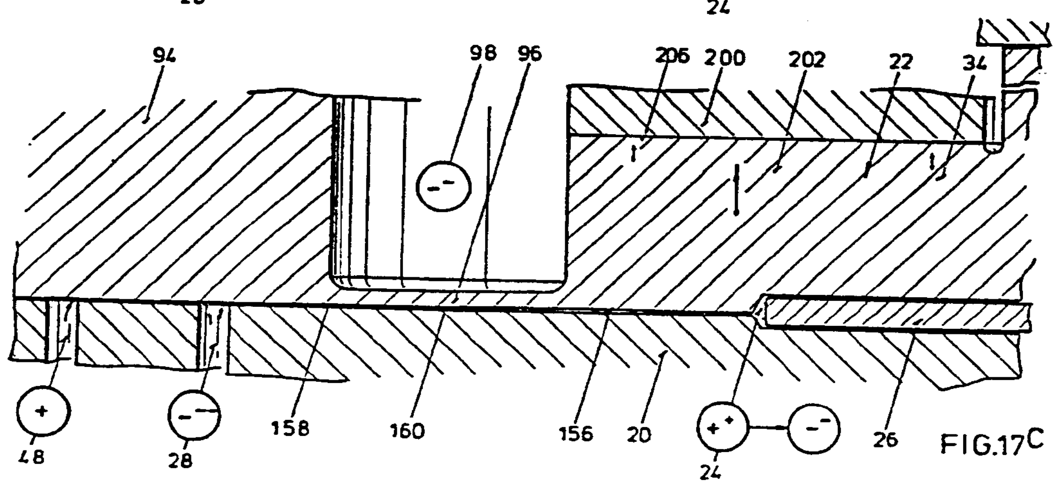


FIG.17C

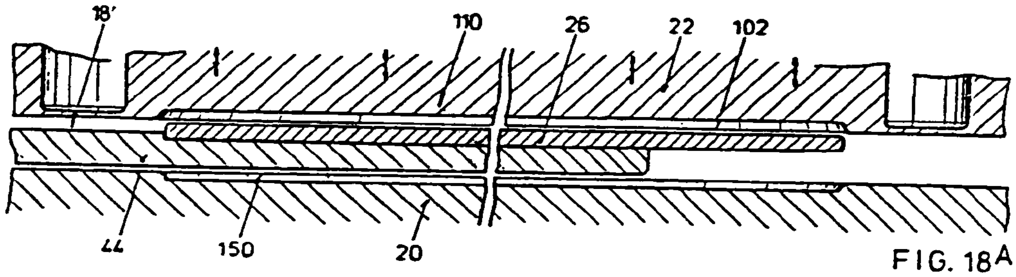


FIG. 18A

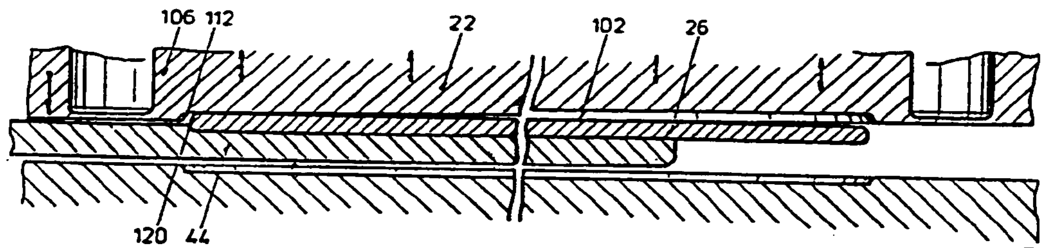


FIG. 18B

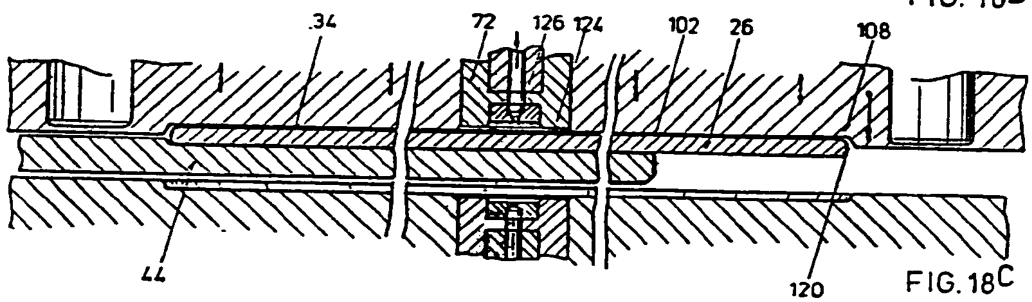


FIG. 18C

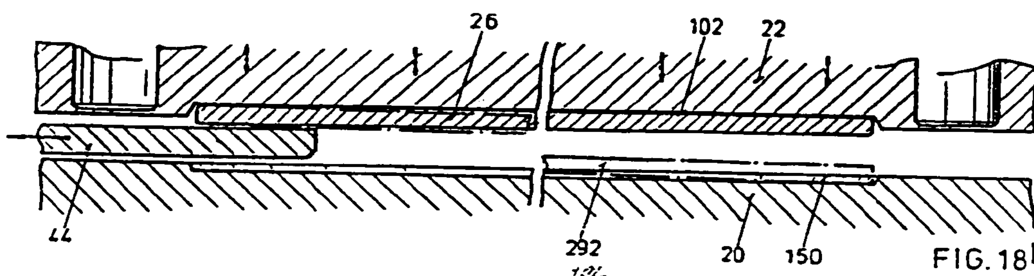


FIG. 18D

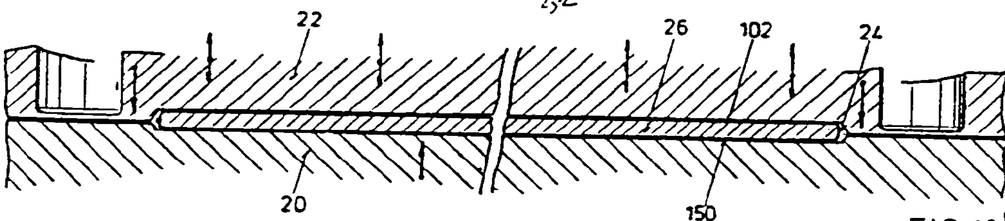


FIG. 18E

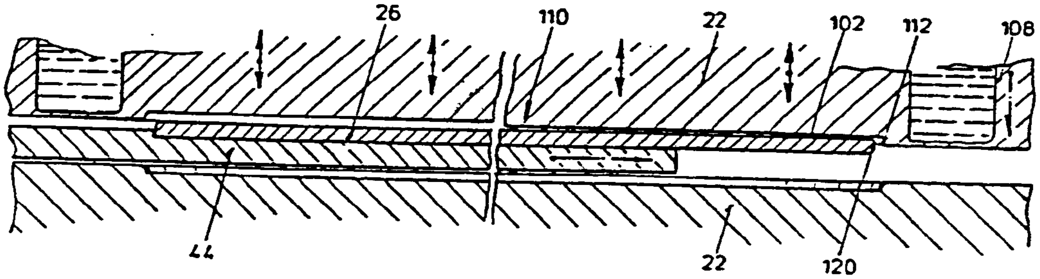


FIG. 19A

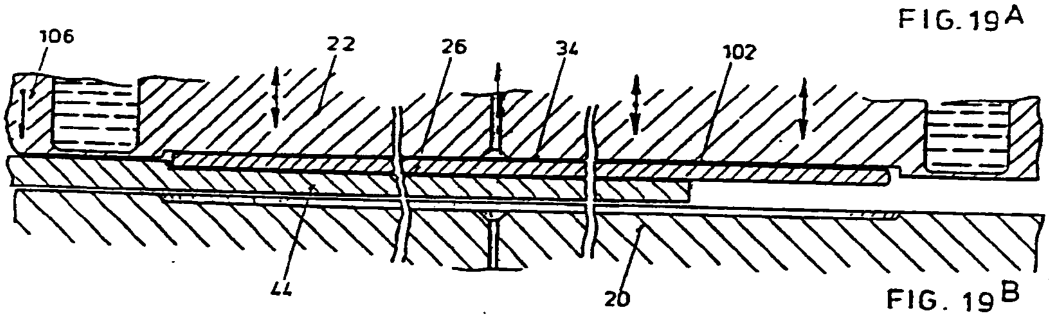


FIG. 19B

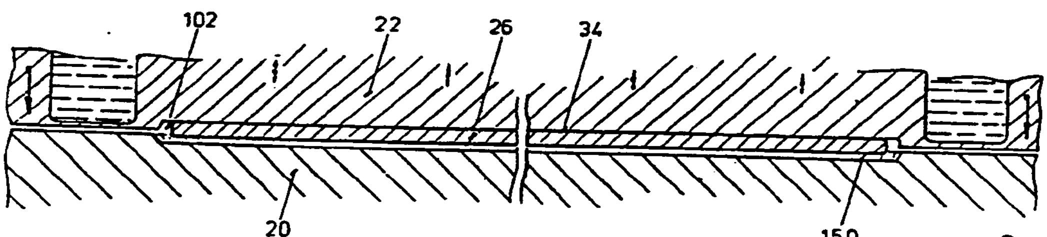


FIG. 19C

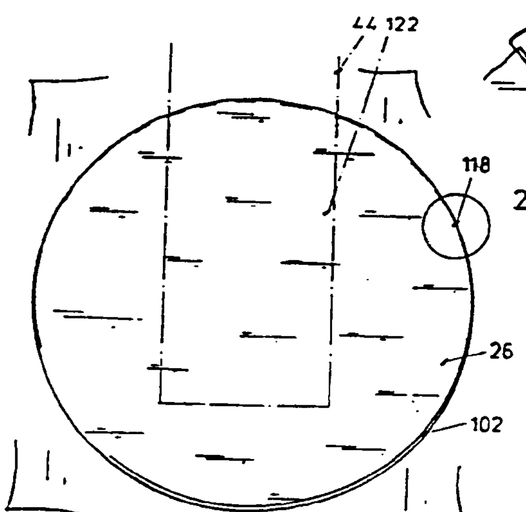


FIG. 20

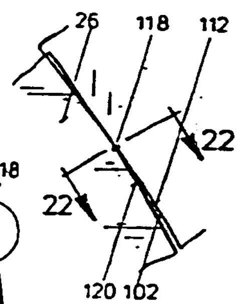


FIG. 21

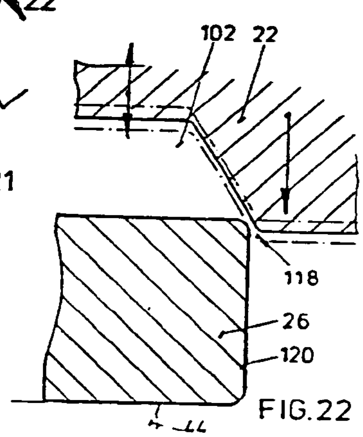


FIG. 22

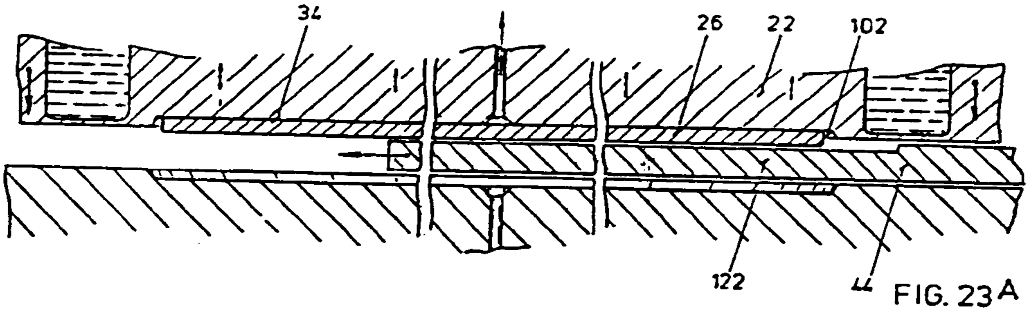


FIG. 23A

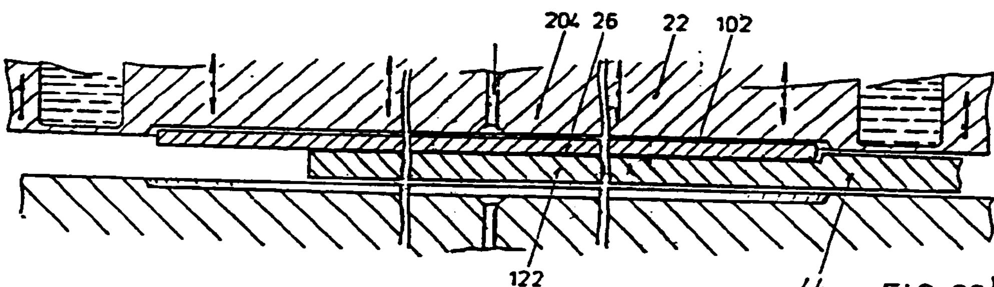


FIG. 23B

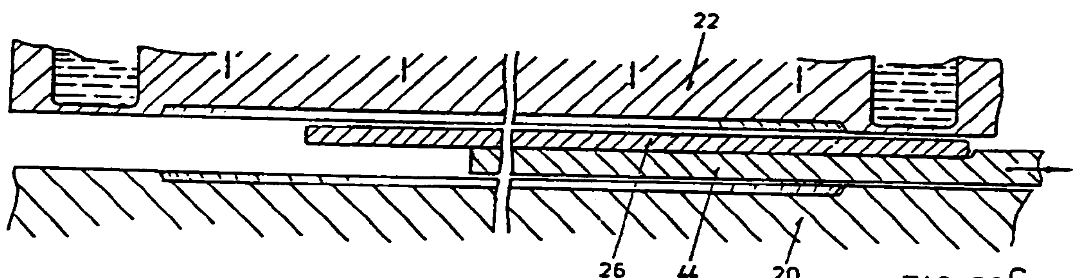


FIG. 23C

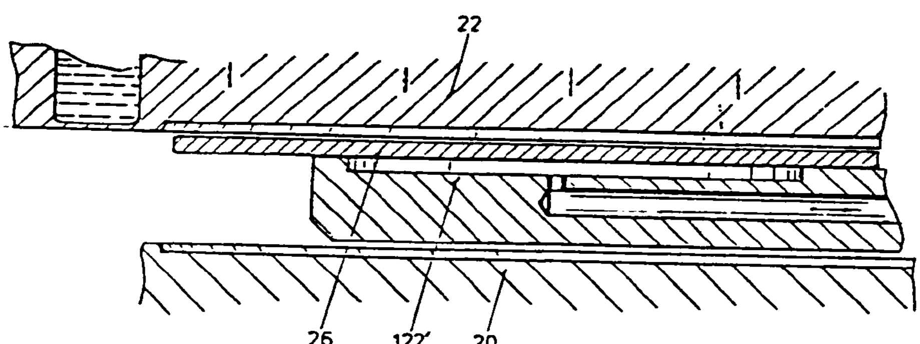


FIG. 23D

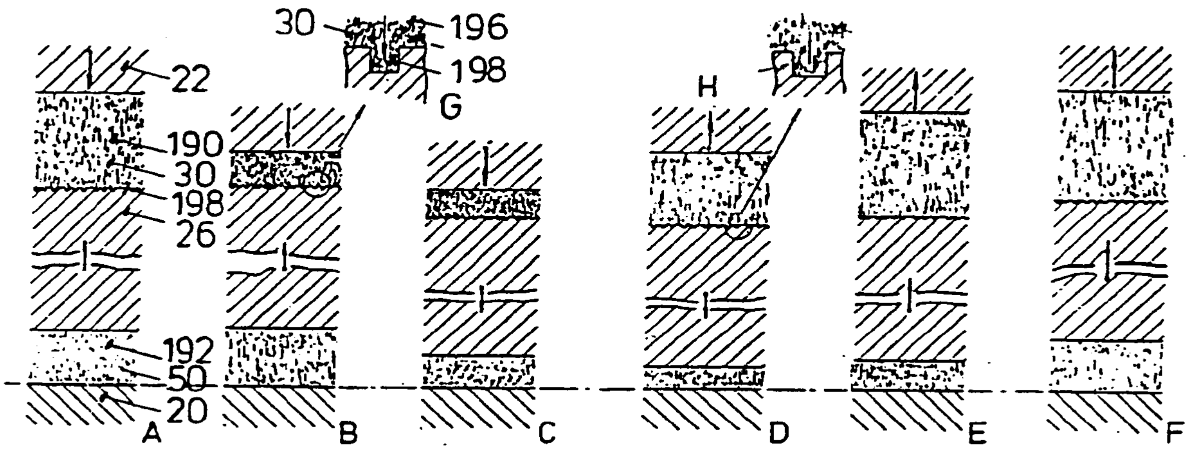


FIG. 25

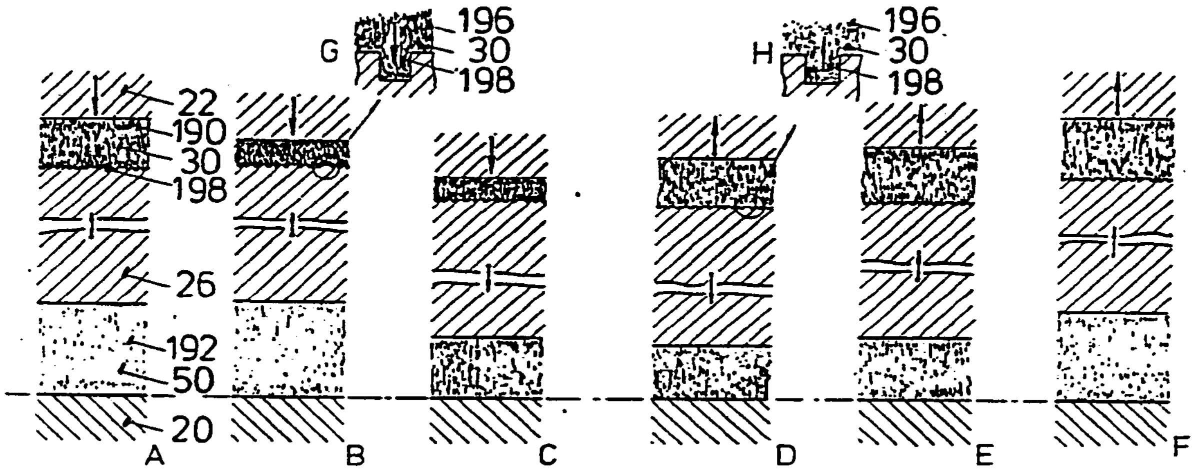


FIG. 24

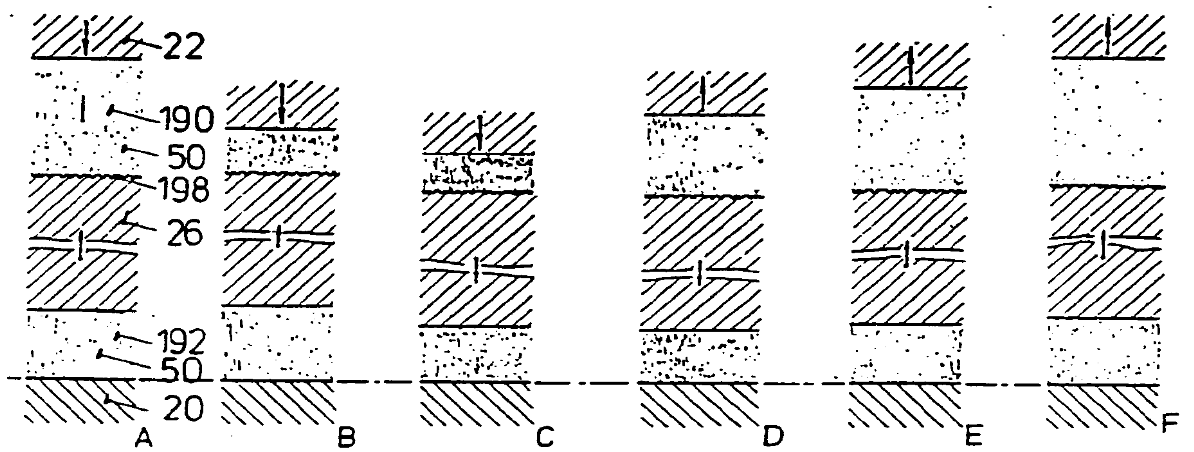
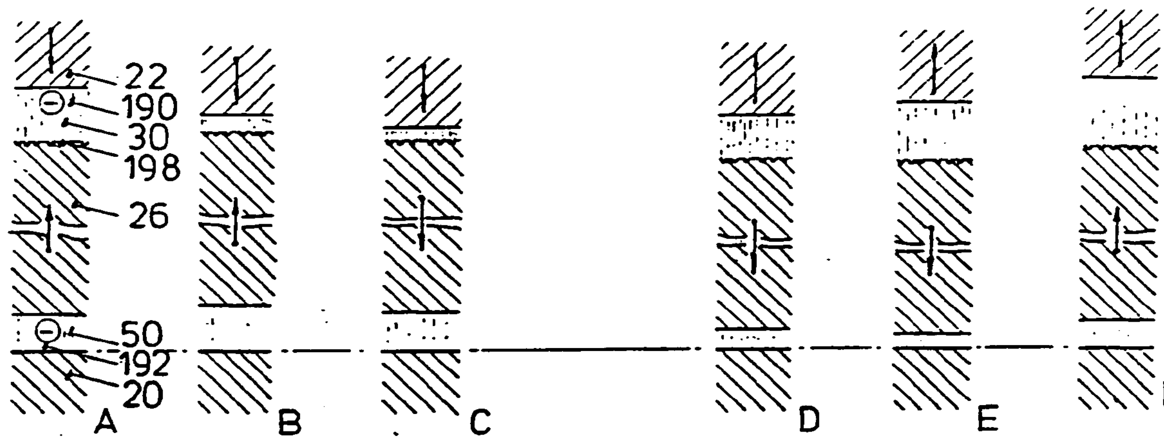


FIG. 26


22
190
30
198
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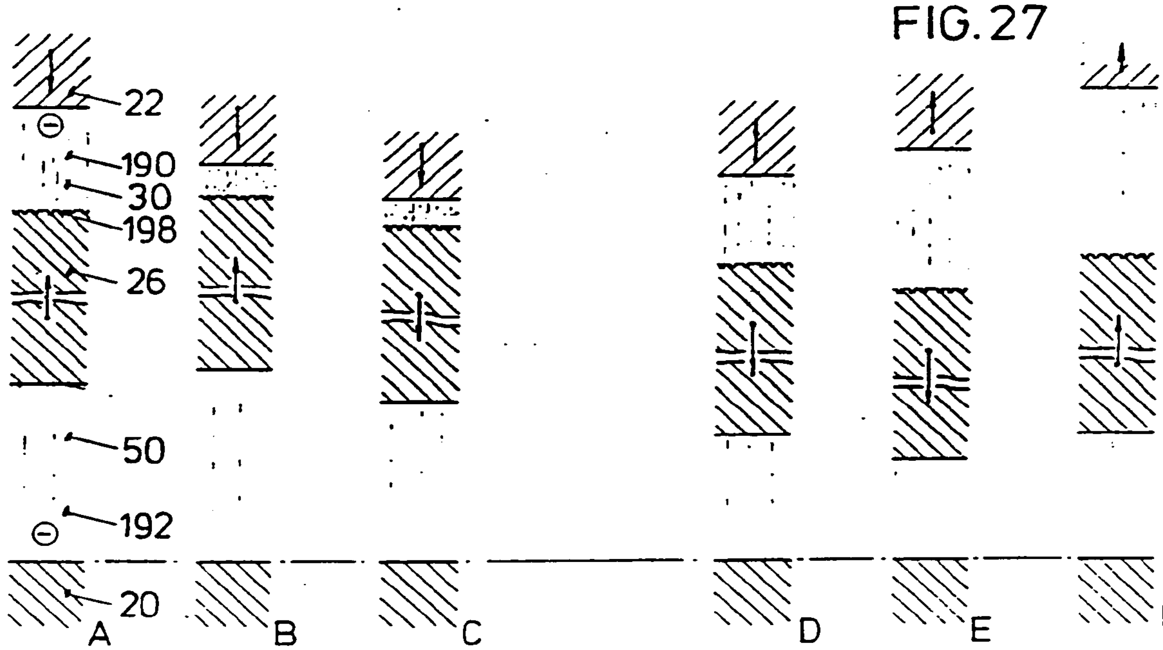
50
192
20
A
B
C
D
E
F

FIG. 27


22
190
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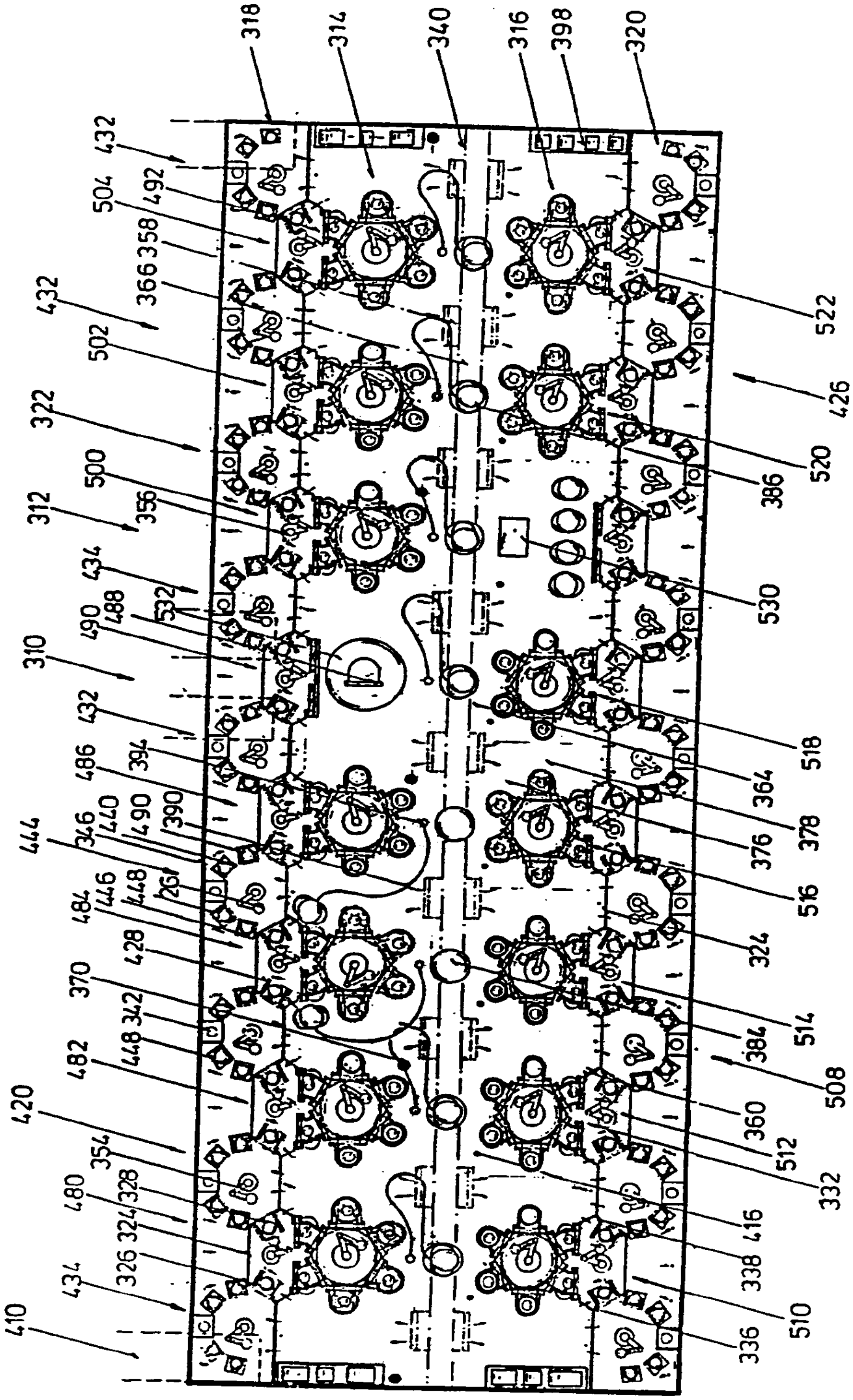
198
26
50
192
20
A
B
C
D
E
F

FIG. 28


318
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502
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490
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310
432
394
486
444
346
440
490
390
261
484
446
448
428
370
342
482
448
420
354
480
328
324
326
434
410
522
426
520
386
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376
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324
514
384
508
360
512
332
416
338
510
336

FIG. 29

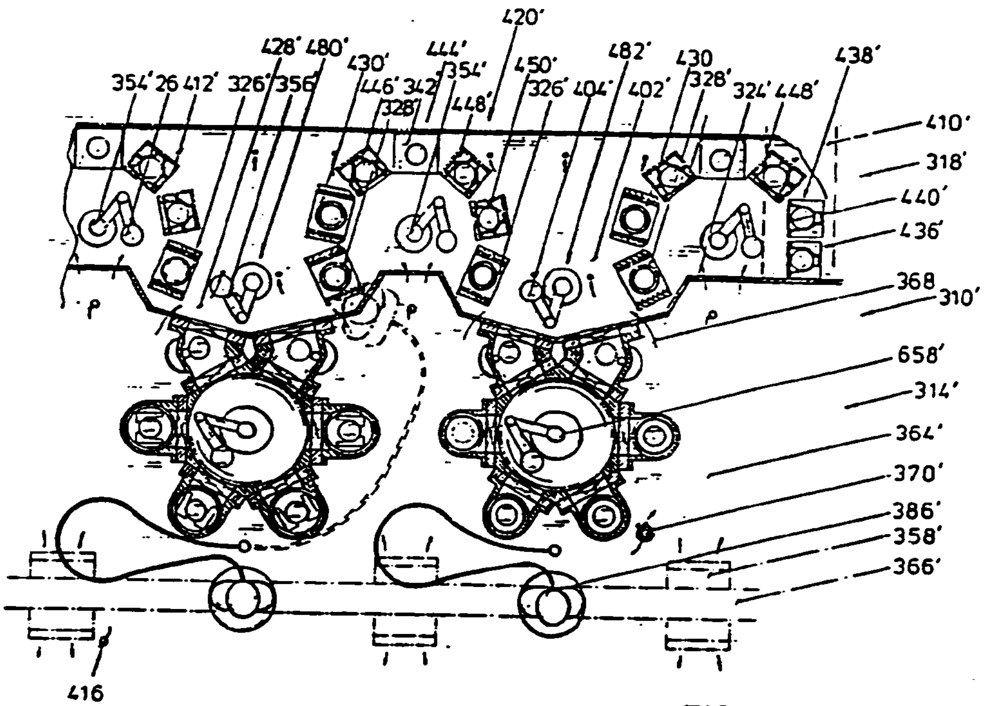
420'
428' 480'
430'
444'
354'
450'
482'
430
438'
354' 26 412' 326' 356
446' 342
326' 404'
402'
328'
324' 448'
328
448'
410'
318'
440'
436'
368
310'
658'
314'
364'
370'
386'
358'
366'
416

FIG. 30

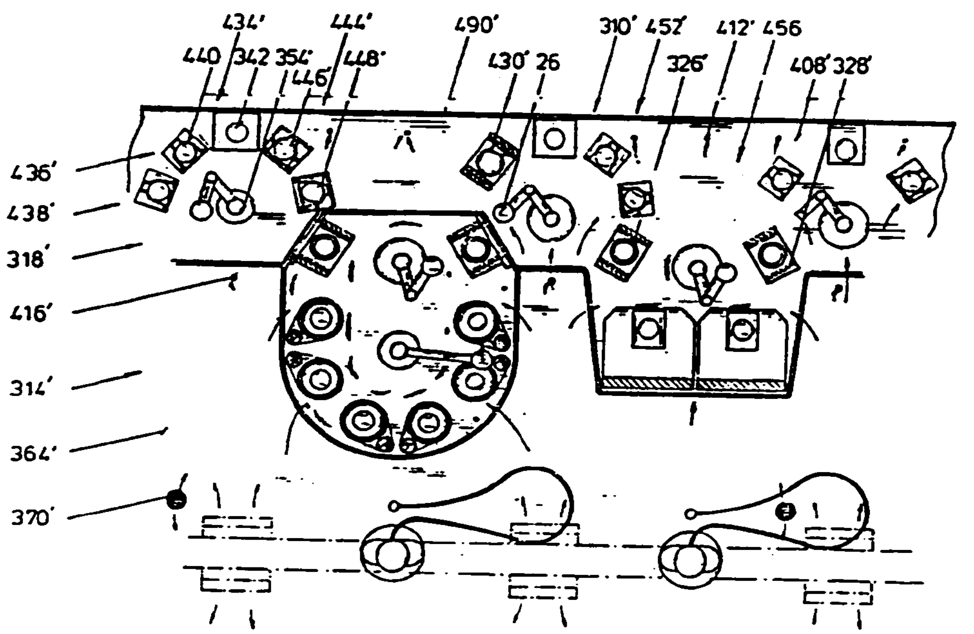
434'
444'
490'
310' 452'
412' 456
440 342 354'
446
448'
430' 26
326'
408' 328'
436'
438'
318'
416'
314'
364'
370'

FIG. 31

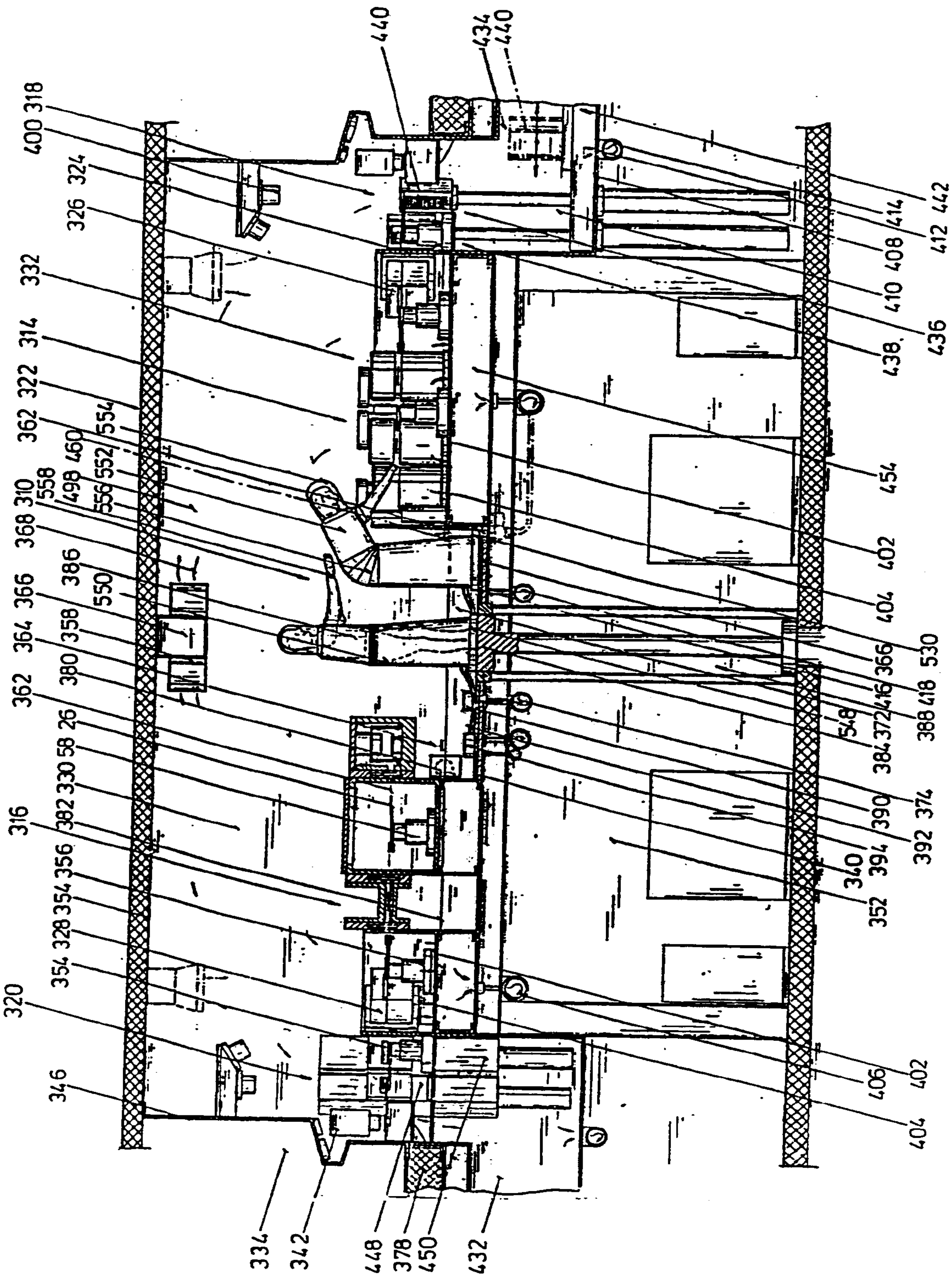

FIG.32

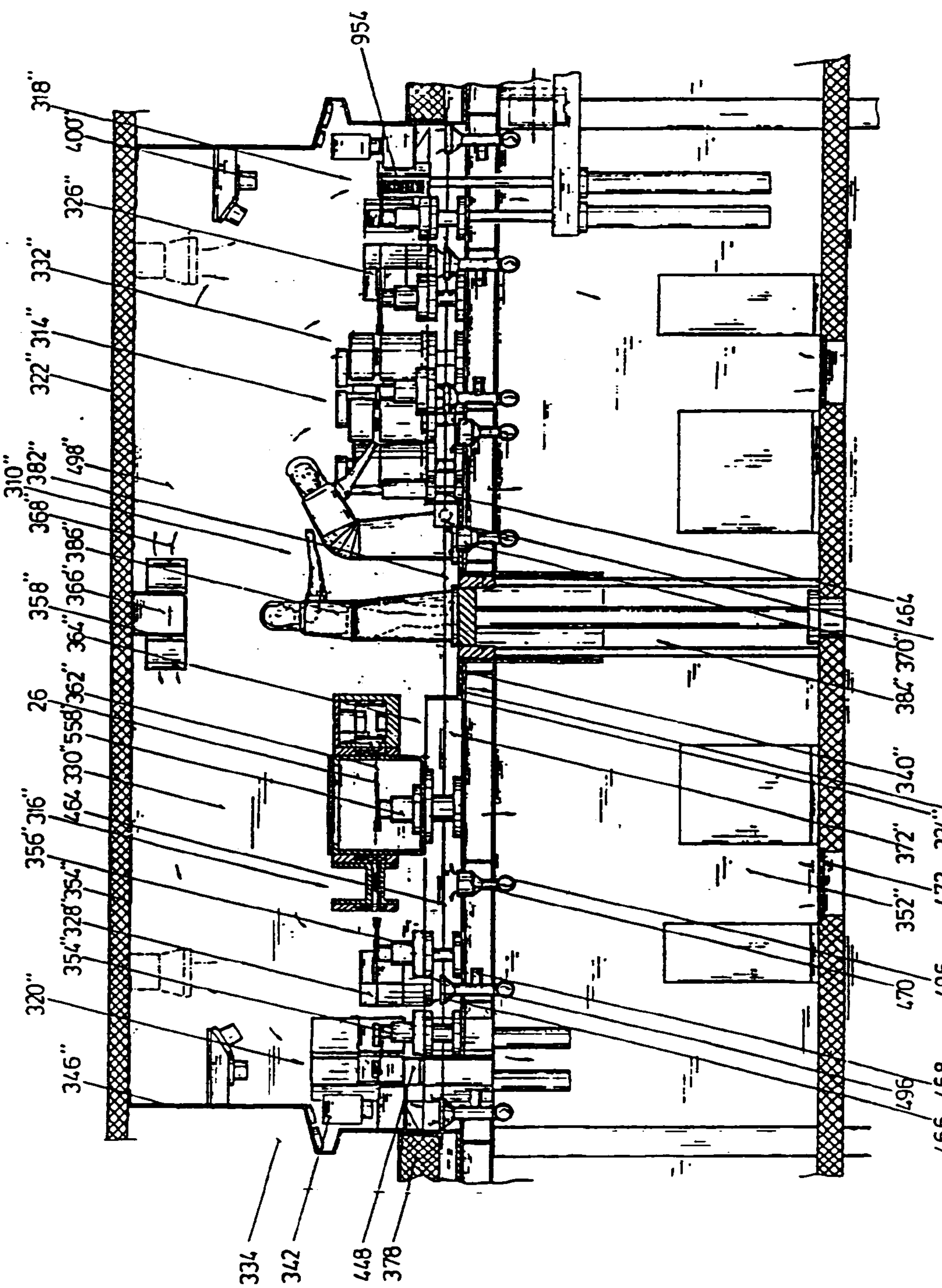
954
318"
400"
326"
332"
314"
322"
498"
382"
310"
368"
386"
366"
358"
364"
362"
26
558
330"
330
464
316"
356"
354"
328"
354"
320"
346"
334
342
448
378
464
370"
384
340"
416
324"
372"
472
352"
470
496
496
468
466

FIG. 33

INTERNATIONAL SEARCH REPORT

International Application No PCT/NL 91/00025

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all) [6]

According to International Patent Classification (IPC) or to both National Classification and IPC

IPC^5: H 01 L 21/00

II. FIELDS SEARCHED

Minimum Documentation Searched [7]

Classification System	Classification Symbols
IPC^5	H 01 L 21/00,B 08 B,B 65 G

Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched [8]

III. DOCUMENTS CONSIDERED TO BE RELEVANT [9]

Category *	Citation of Document, [11] with indication, where appropriate, of the relevant passages [12]	Relevant to Claim No. [13]
A	WO, A1, 87/04 853 (BOK et al.) 13 August 1987 (13.08.87), see page 3, line 10 - page 4, line 38; claims; fig. --	1,121
A	WO, A1, 86/01 034 (BOK) 13 February 1986 (13.02.86), see claims; fig. --	1,121
A	US, A, 4 681 776 (BOK) 21 July 1987 (21.07.87), see claims; fig. ----	1,121

* Special categories of cited documents: [10]

"A" document defining the general state of the art which is not considered to be of particular relevance

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"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

IV. CERTIFICATION

Date of the Actual Completion of the International Search	Date of Mailing of this International Search Report
27 May 1991	- 3. 06. 91
International Searching Authority	**Signature of Authorized Officer**
EUROPEAN PATENT OFFICE	M. PEIS M. Peis

ANHANG
zum internationalen Recherchenbericht über die internationale Patentanmeldung Nr.

ANNEX
to the International Search Report to the International Patent Application No.

ANNEXE
au rapport de recherche international relatif á la demande de brevet international n°

PCT/NL91/00025 SAE 44576

In diesem Anhang sind die Mitglieder der Patentfamilien der im obengenannten internationalen Recherchenbericht angeführten Patentdokumente angegeben. Diese Angaben dienen nur zur Unterrichtung und erfolgen ohne Gewähr.

This Annex lists the patent family members relating to the patent documents cited in the above-mentioned international search report. The Office is in no way liable for these particulars which are given merely for the purpose of information.

La présente annexe indique les membres de la famille de brevets relatifs aux documents de brevets cités dans le rapport de recherche international visée ci-dessus. Les reseignements fournis sont donnés á titre indicatif et n'engagent pas la responsibilité de l'Office.

Im Recherchenbericht angeführtes Patentdokument Patent document cited in search report Document de brevet cité dans le rapport de recherche	Datum der Veröffentlichung Publication date Date de publication	Mitglied(er) der Patentfamilie Patent family member(s) Membre(s) de la famille de brevets	Datum der Veröffentlichung Publication date Date de publication
WO-A1- 8704853	13-08-87	EP-A1- 261145	30-03-88
		JP-T2-63503024	02-11-88
		NL-A - 8601255	16-12-87
		NL-A - 8601132	01-12-87
		NL-A - 8601131	01-12-87
		NL-A - 8600947	02-11-87
		NL-A - 8600946	02-11-87
		NL-A - 8600762	16-10-87
		NL-A - 8600408	16-09-87
		NL-A - 8600255	01-09-87
WO-A1- 8601034	13-02-86	AU-A1-46711/85	25-02-86
		EP-A1- 188593	30-07-86
		NL-A - 8402410	03-03-86
		US-A - 4662987	05-05-87
US-A - 4681776	21-07-87	AU-A1-44008/85	31-12-85
		EP-A1- 182855	04-06-86
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		WO-A1- 8505757	19-12-85

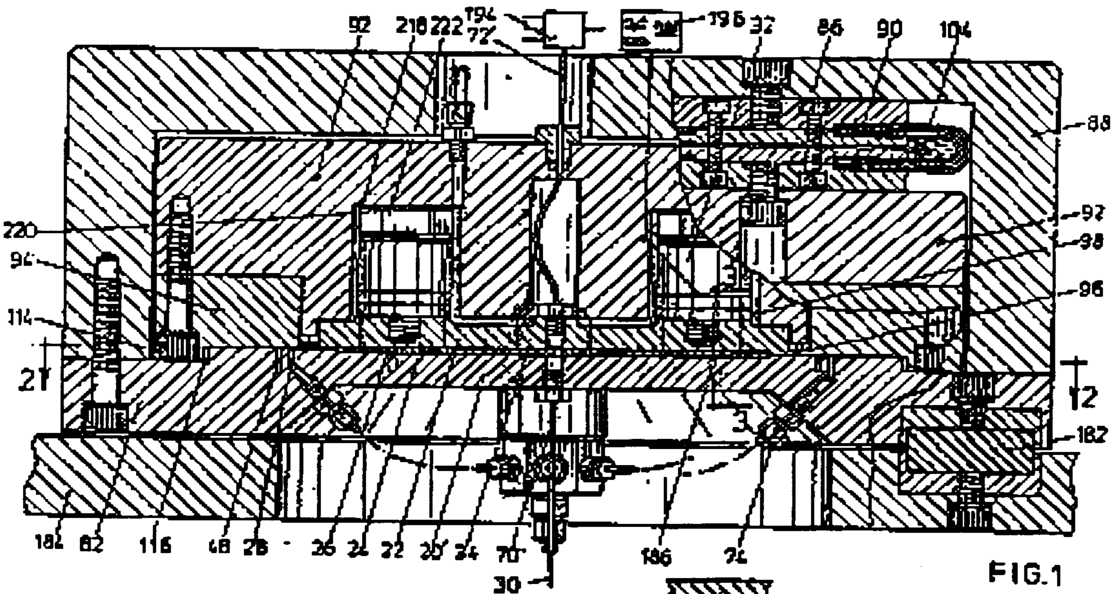

FIG.1

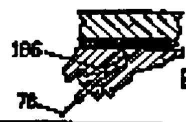

FIG.3

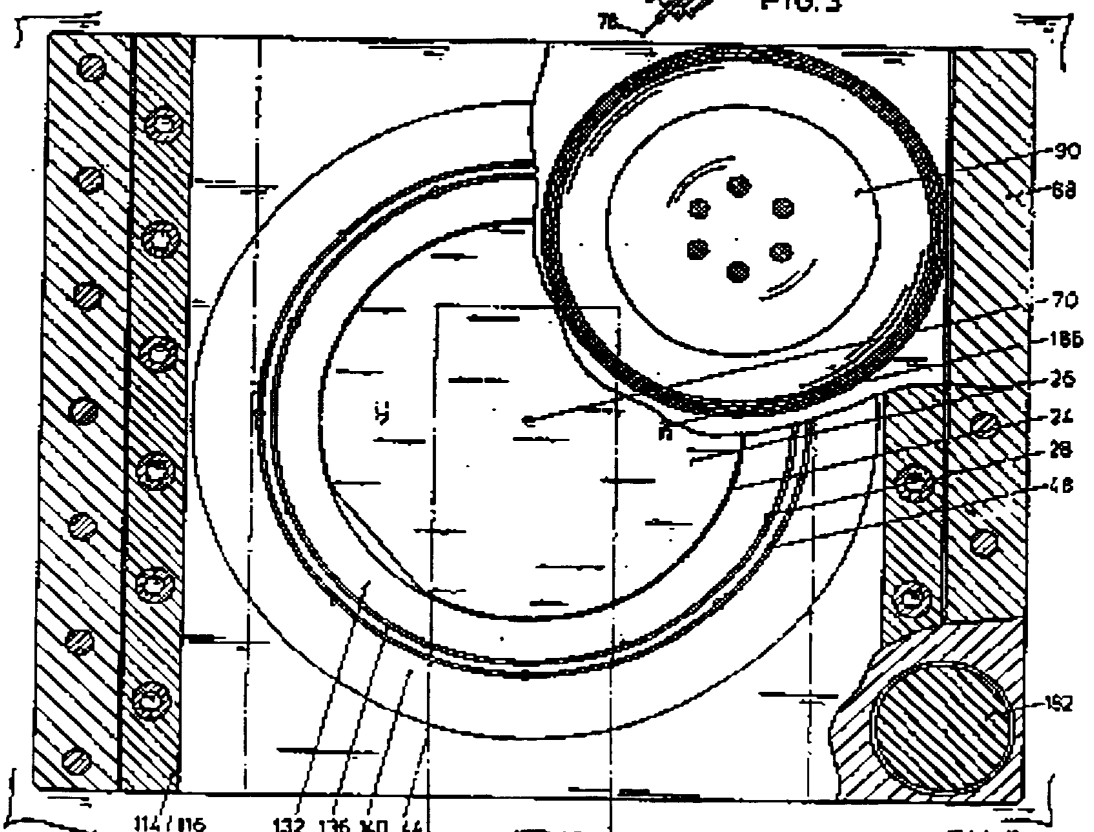

FIG.2

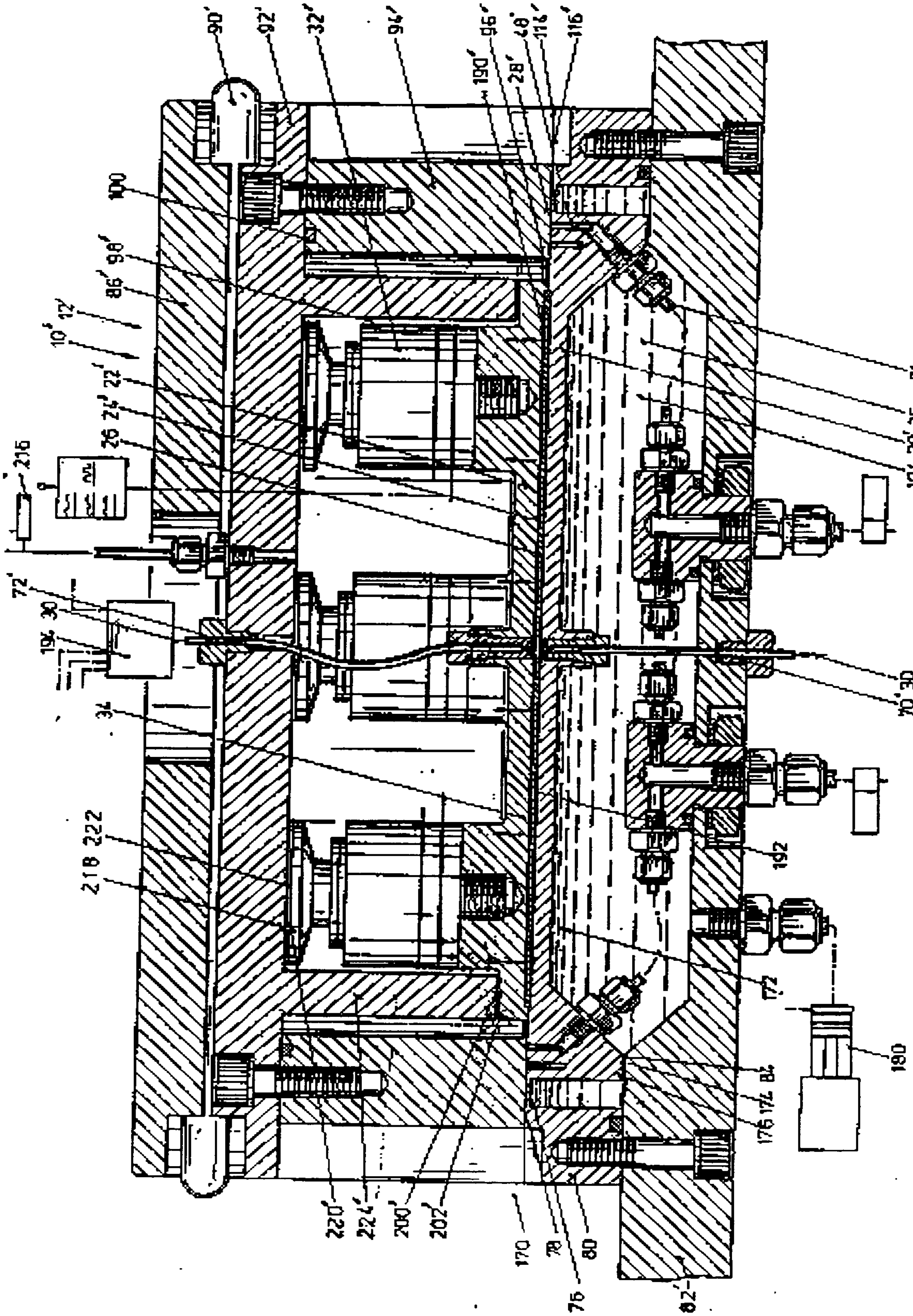

FIG. 4

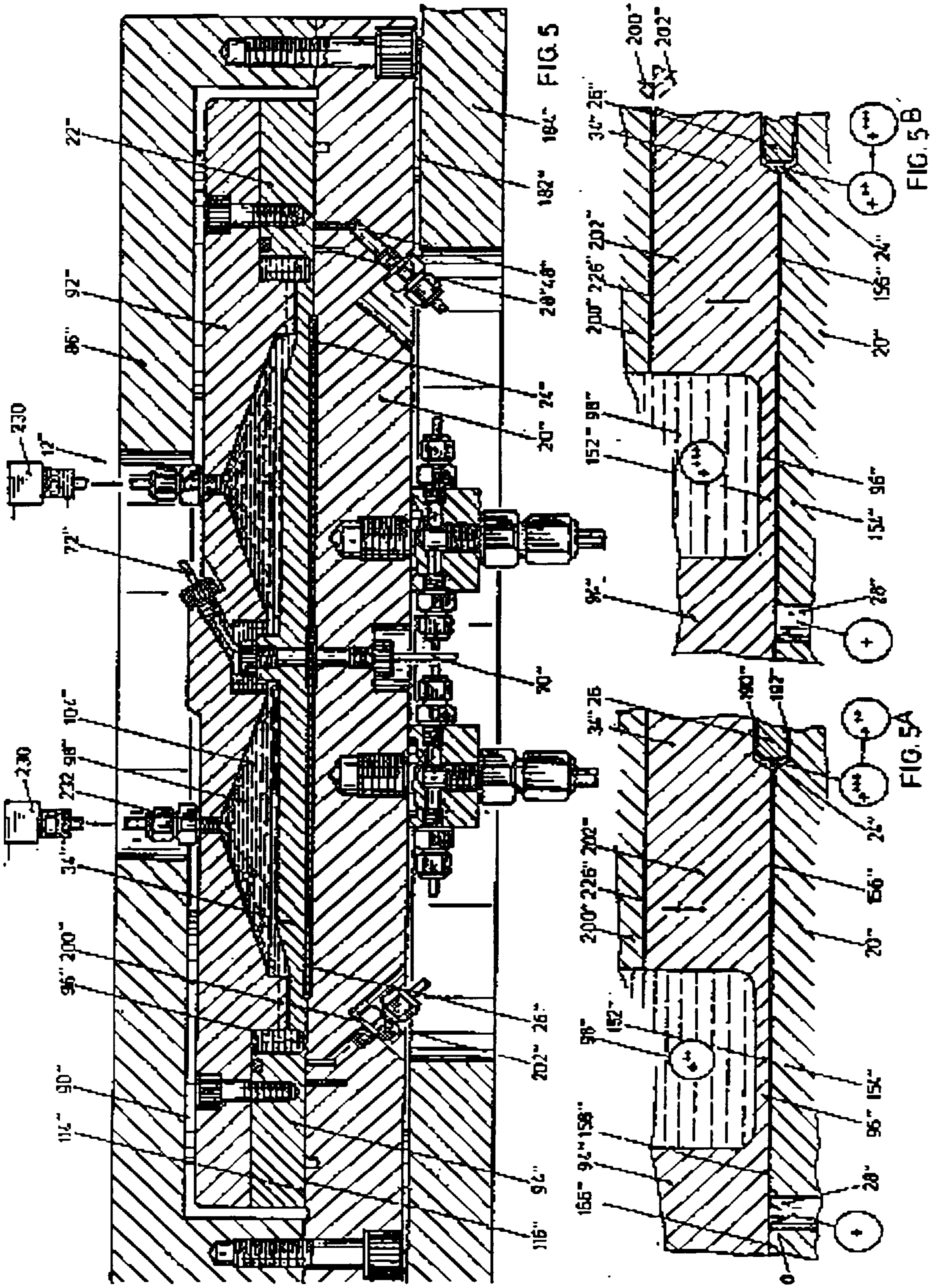

FIG. 5

FIG. 5A

FIG. 5B

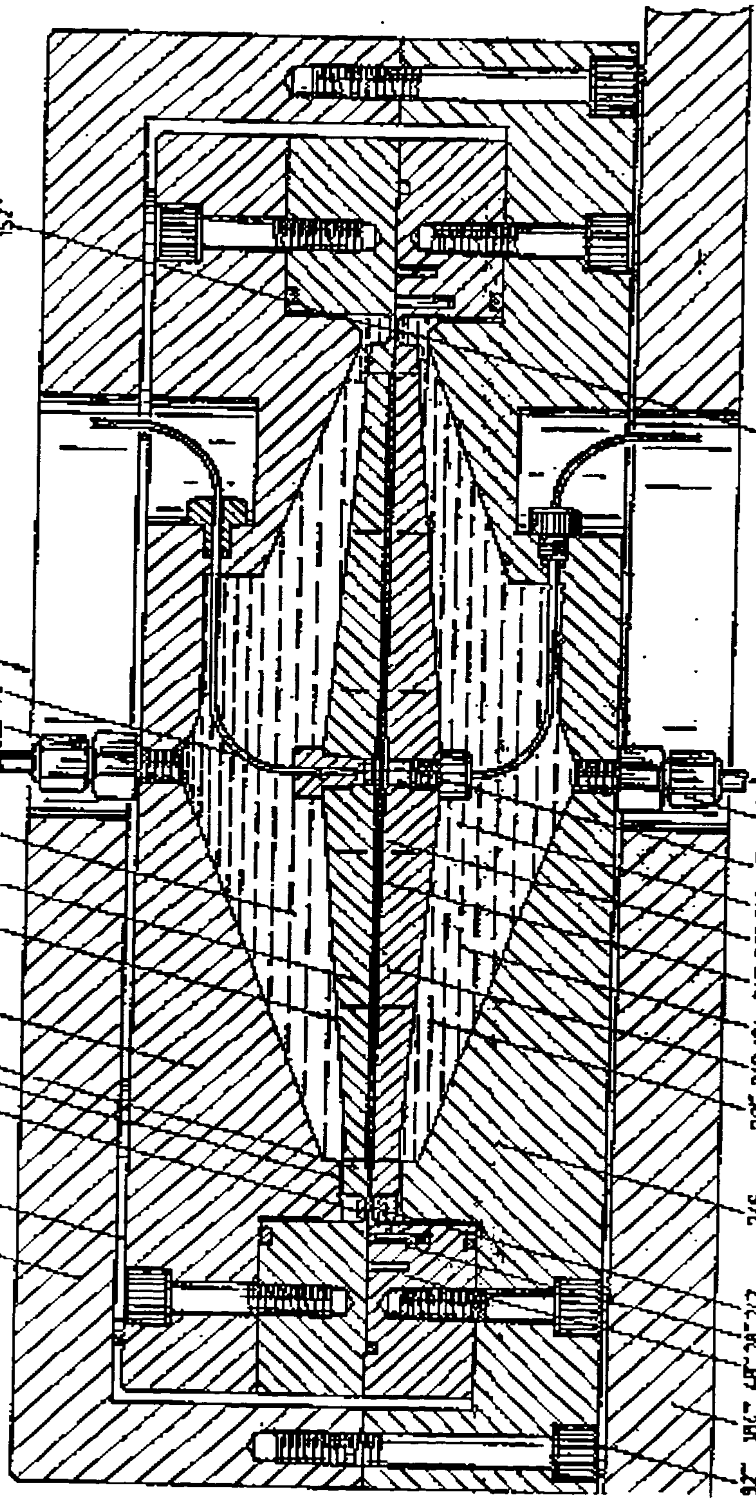

FIG.6

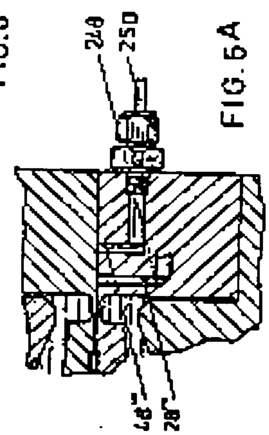

FIG.6A

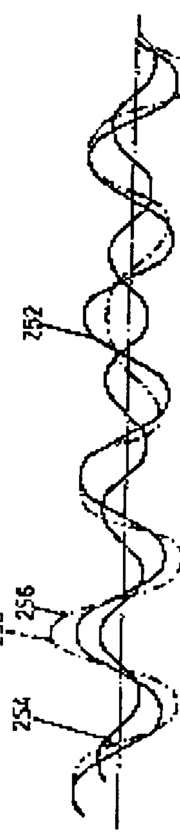

FIG.6B

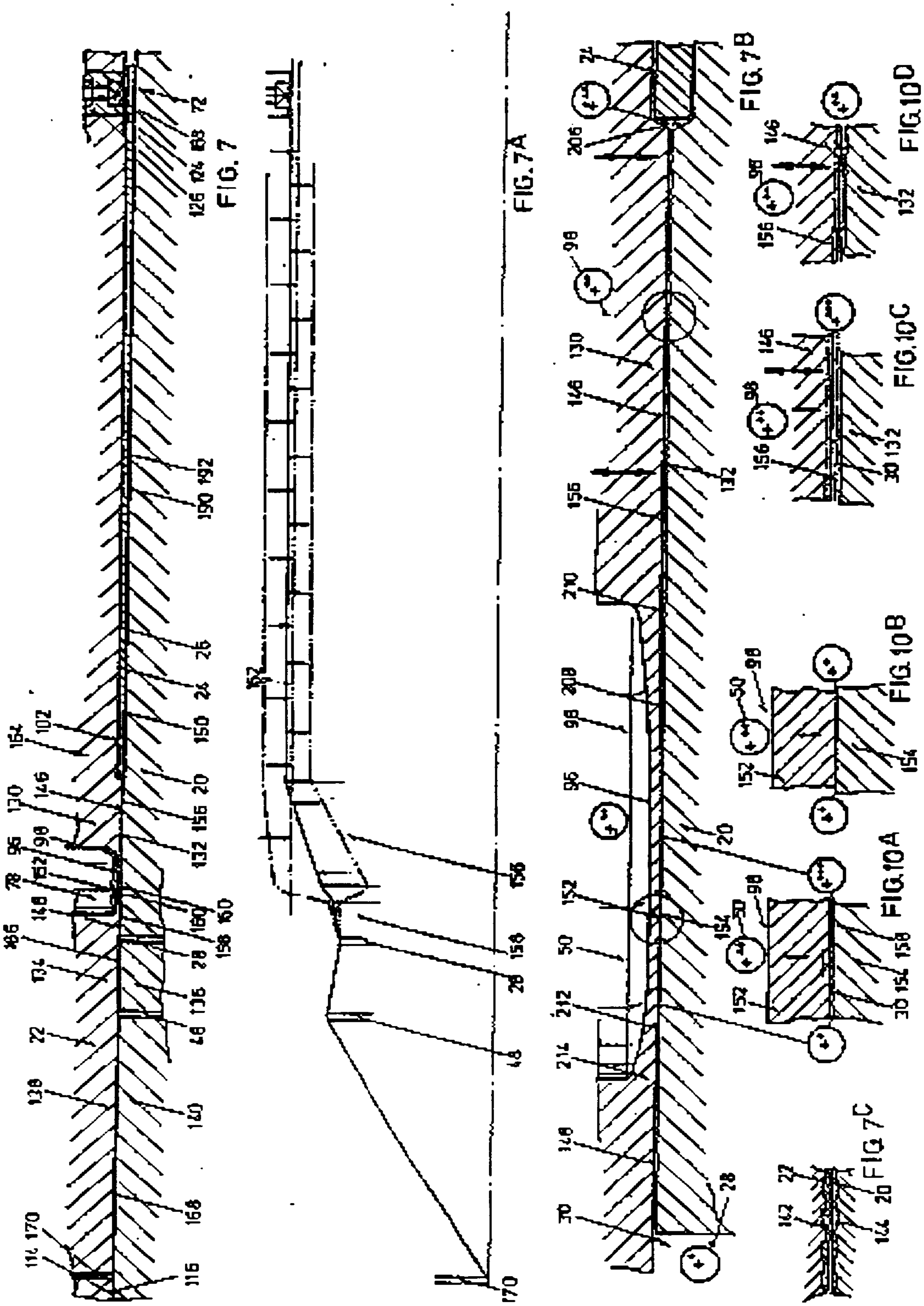
FIG. 7
FIG. 7A
FIG. 7B
FIG. 7C
FIG. 10A
FIG. 10B
FIG. 10C
FIG. 10D

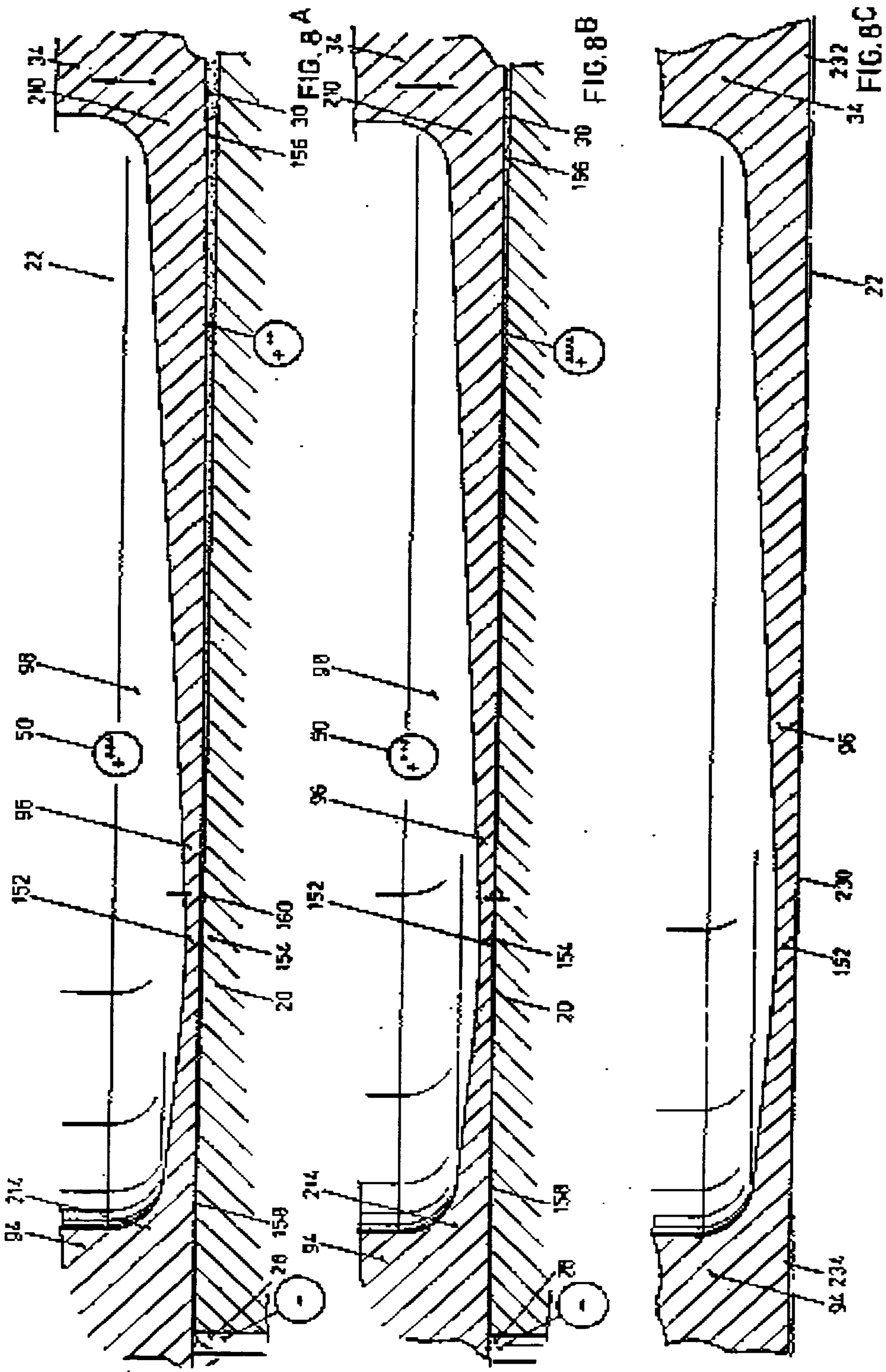

FIG. 8A

FIG. 8B

FIG. 8C

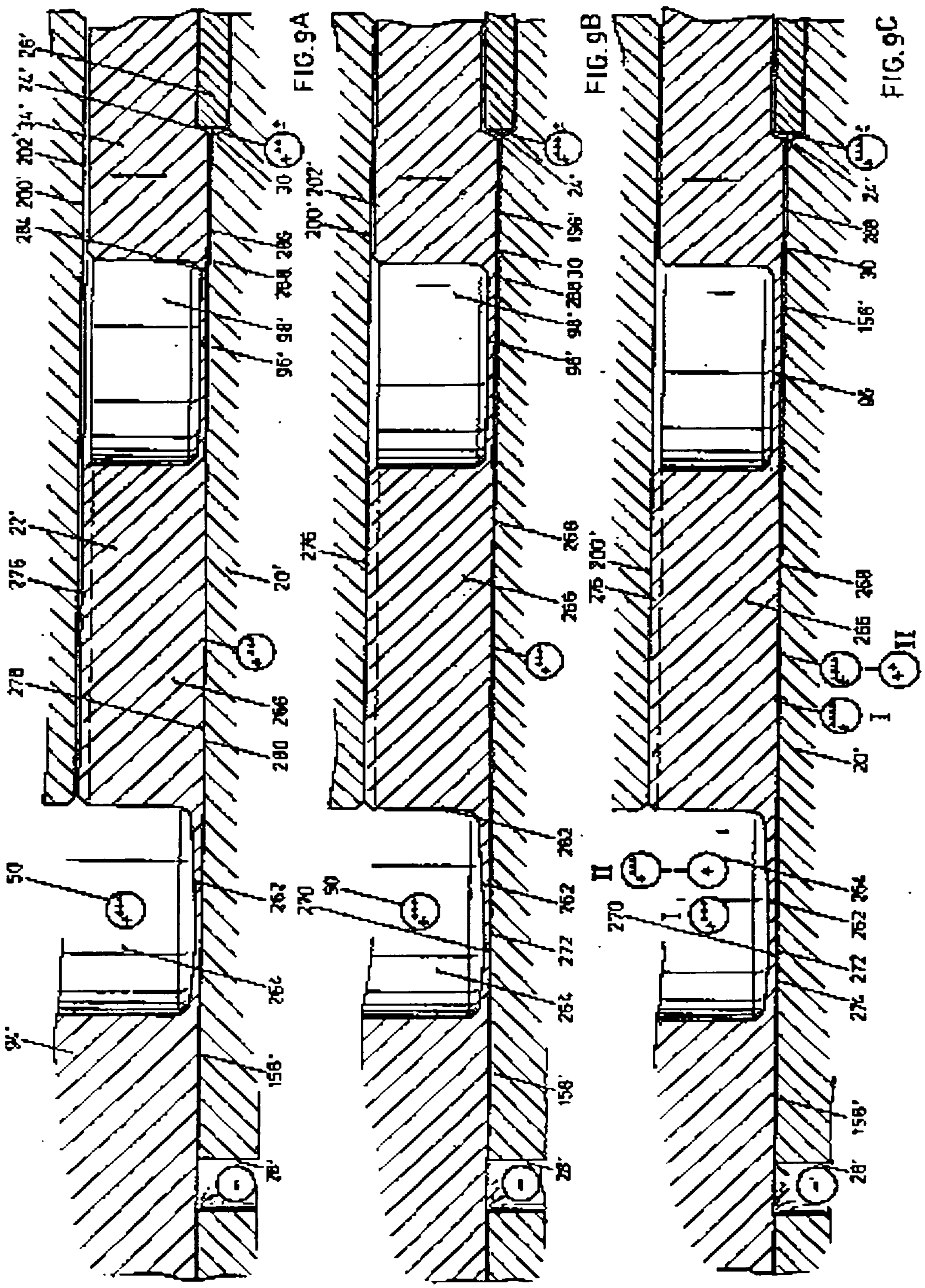

FIG.9A FIG.9B FIG.9C

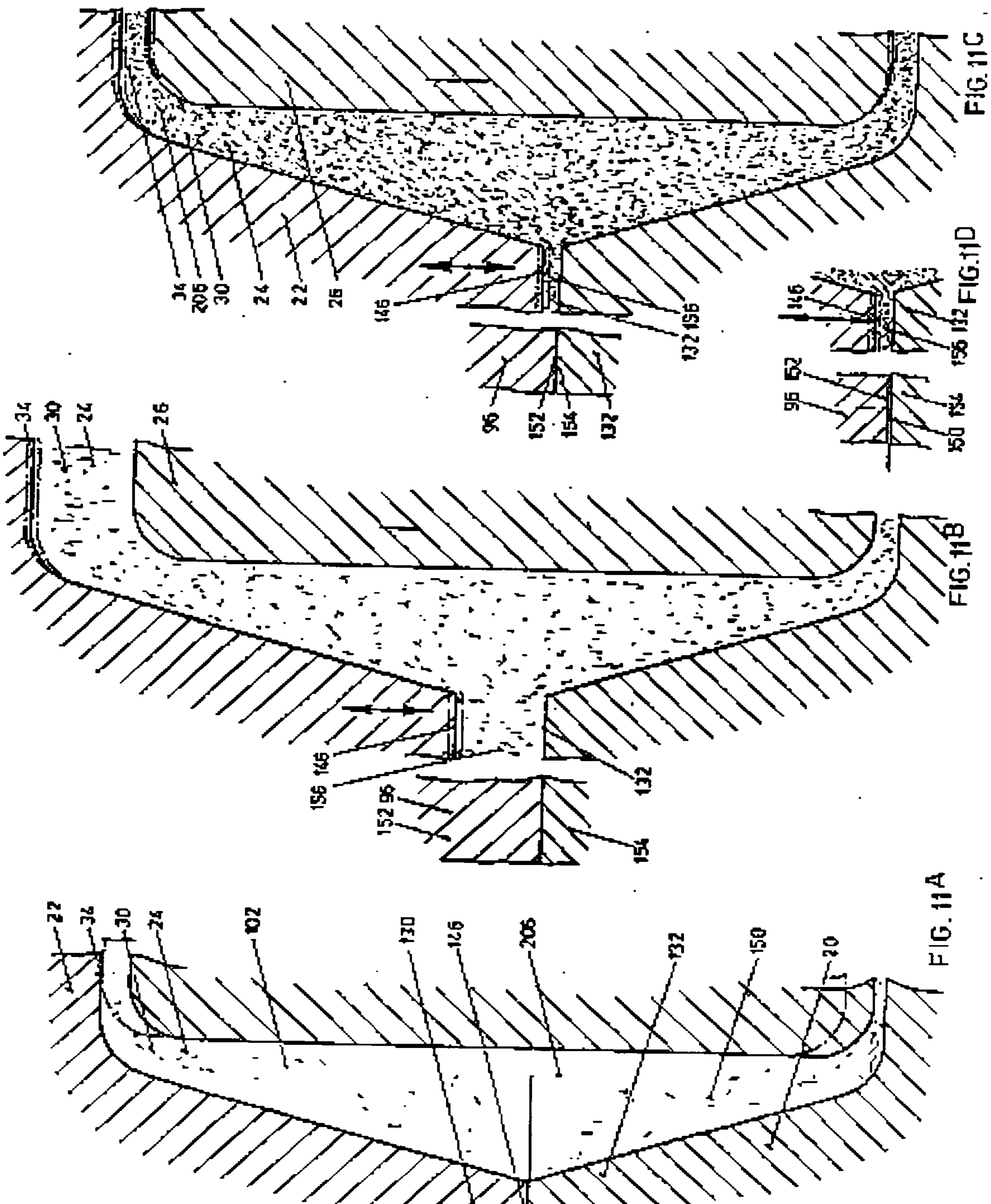

FIG.11C

FIG.11D

FIG.11B

FIG.11A

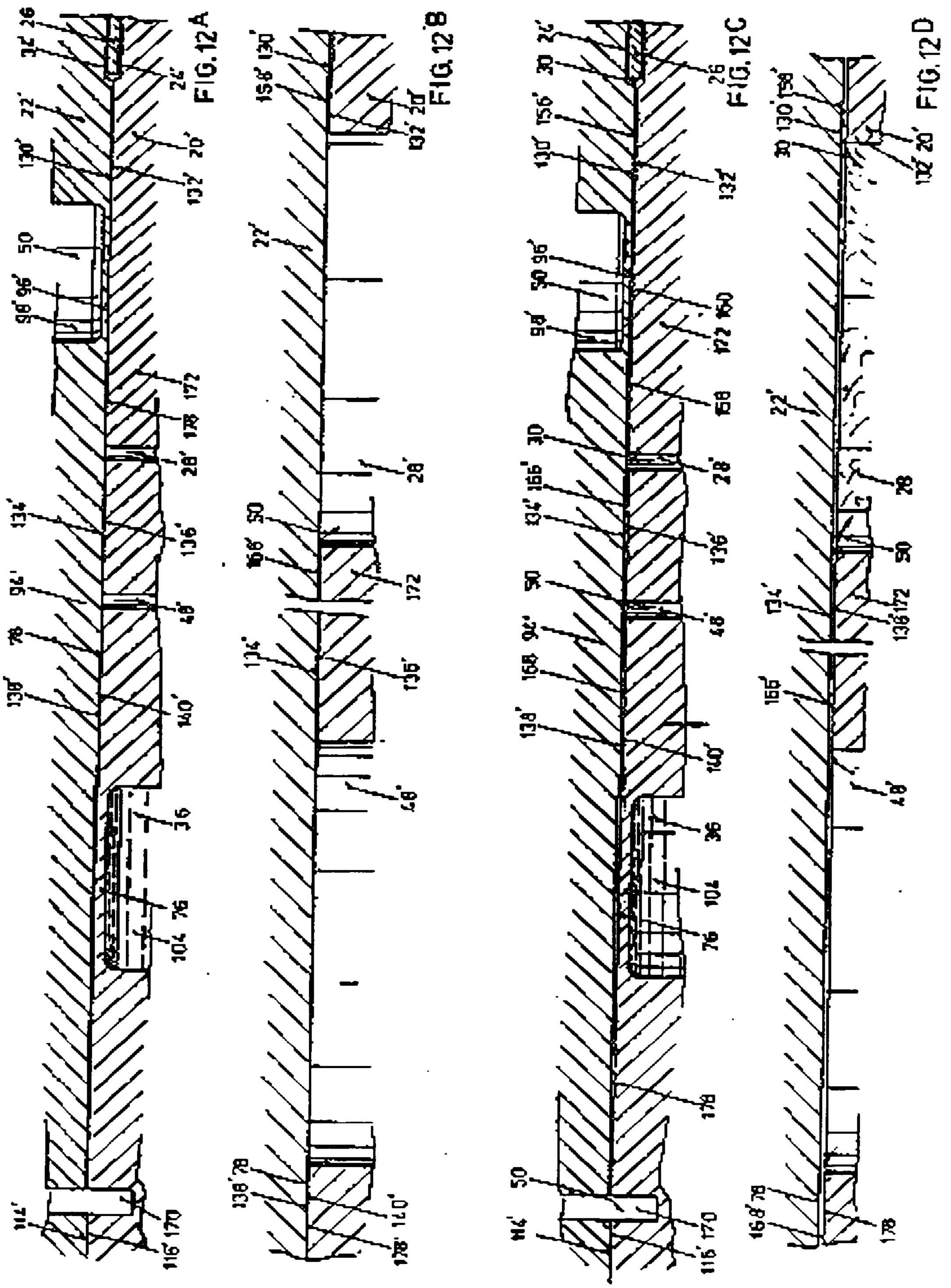

FIG.12A

FIG.12B

FIG.12C

FIG.12D

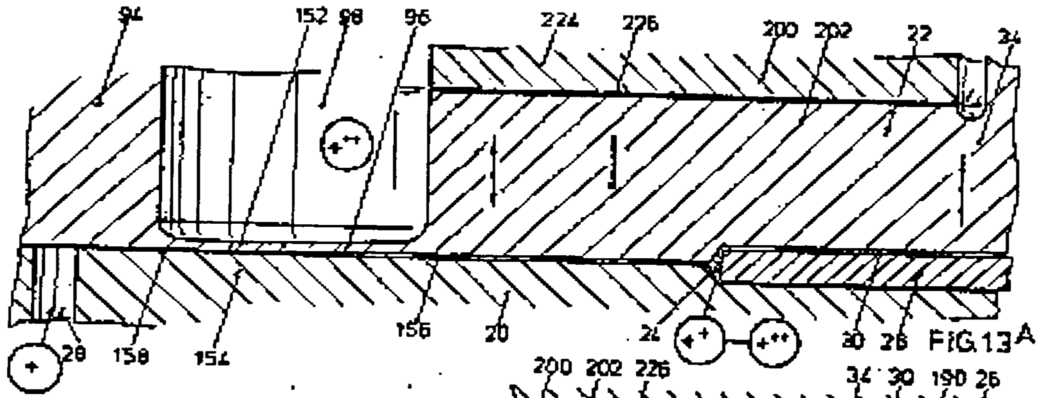

FIG.13A

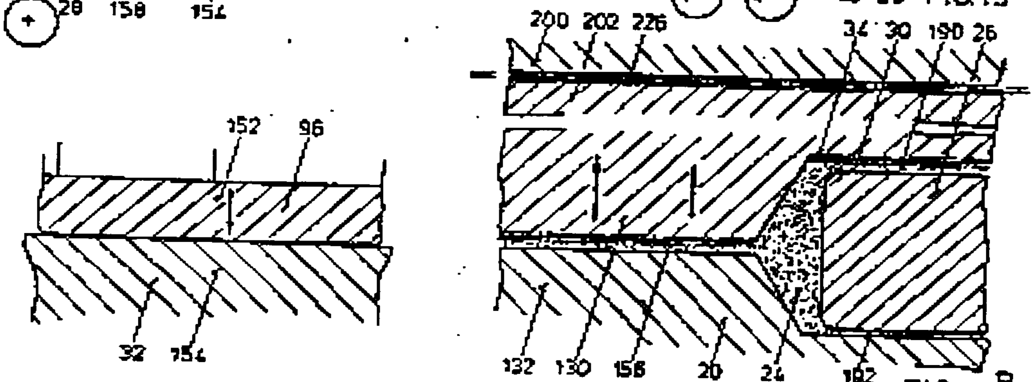

FIG.13B

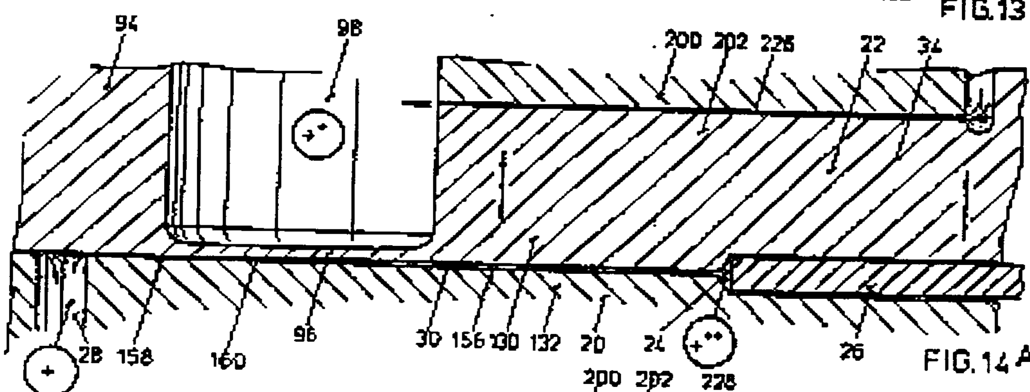

FIG.14A

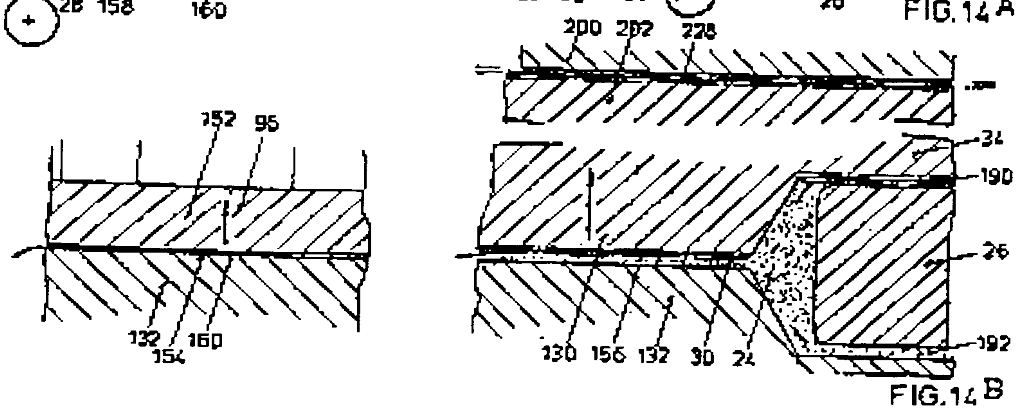

FIG.14B

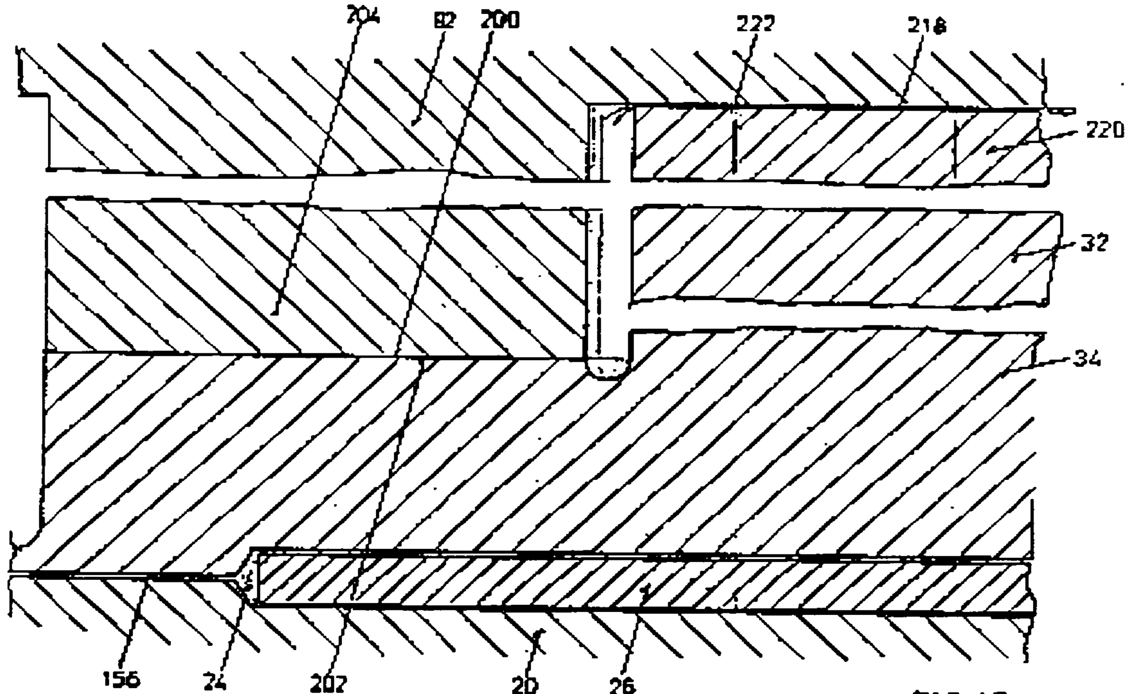

FIG.15

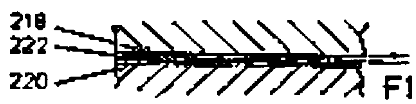

FIG.16B

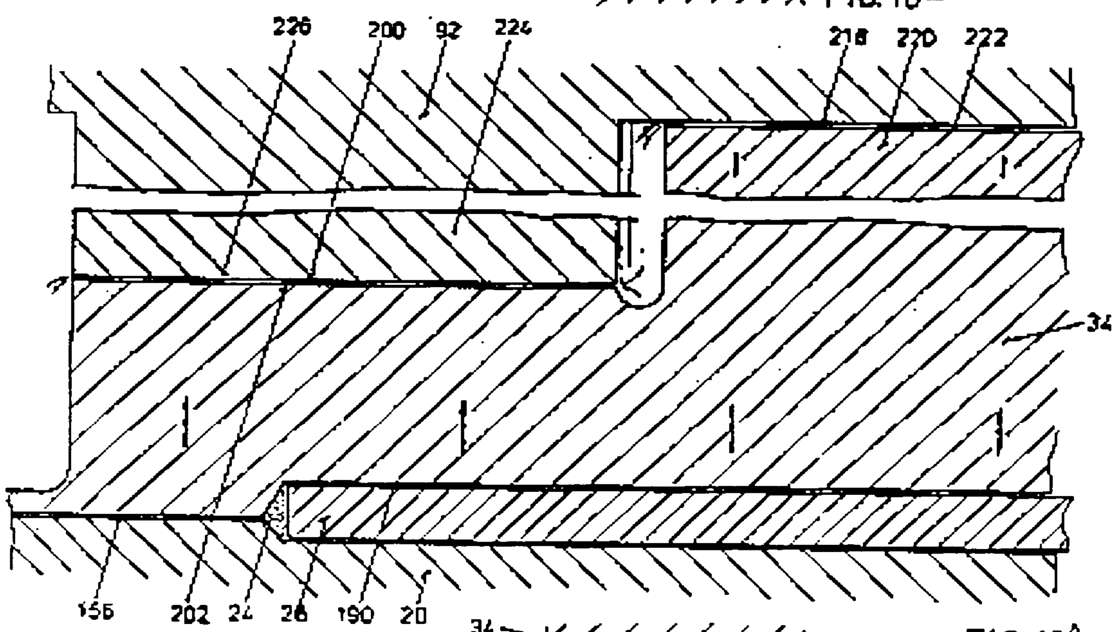

FIG.16A

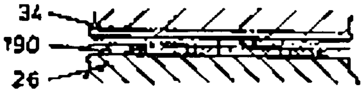

FIG.16C

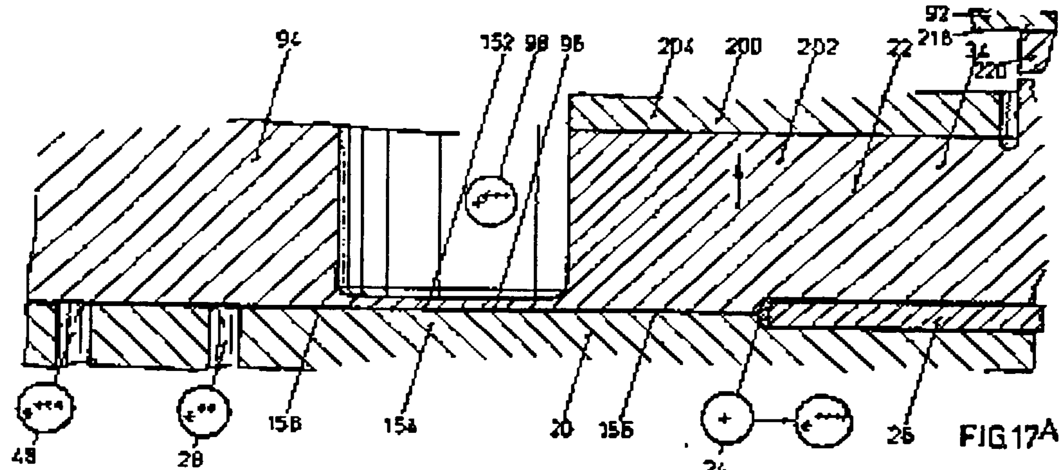

FIG.17A

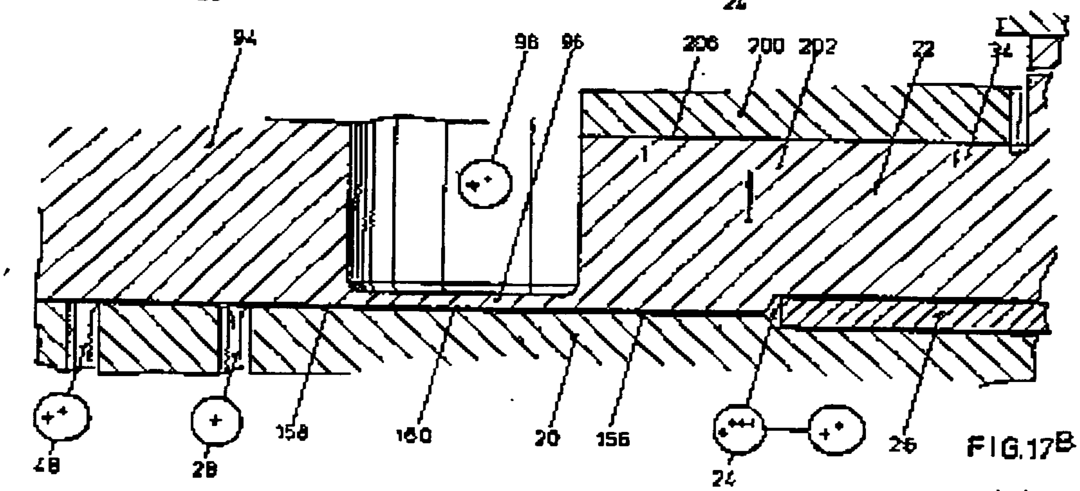

FIG.17B

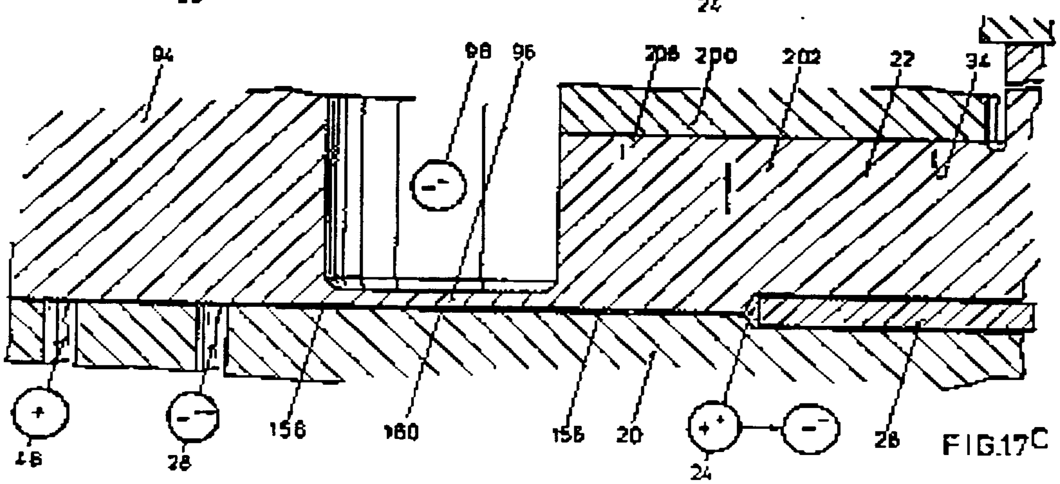

FIG.17C

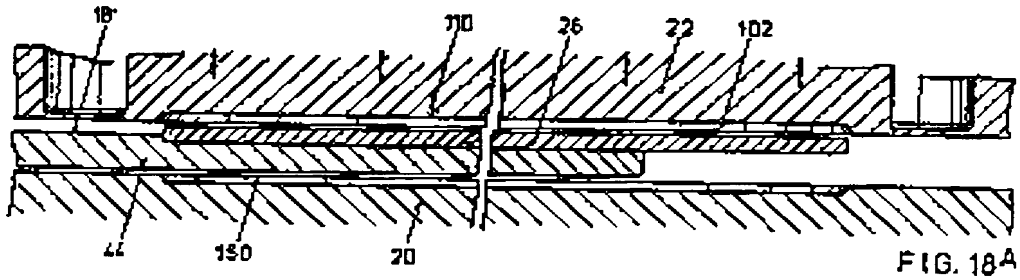

FIG. 18A

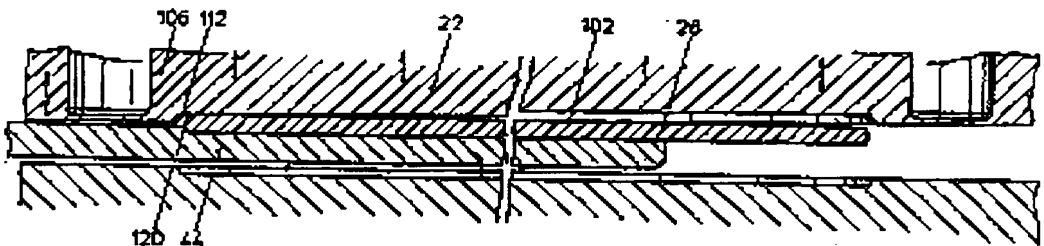

FIG. 18B

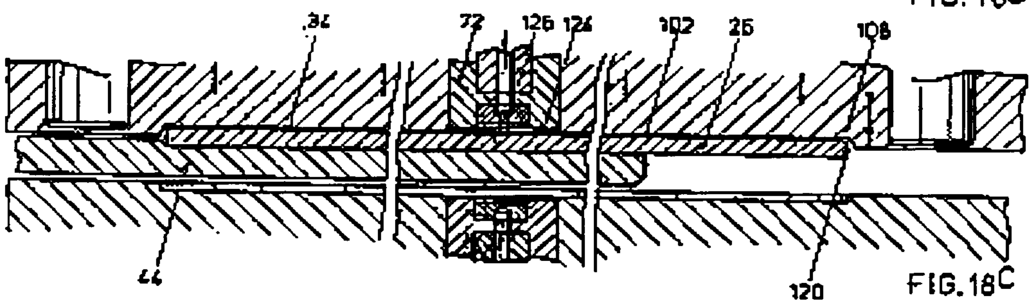

FIG. 18C

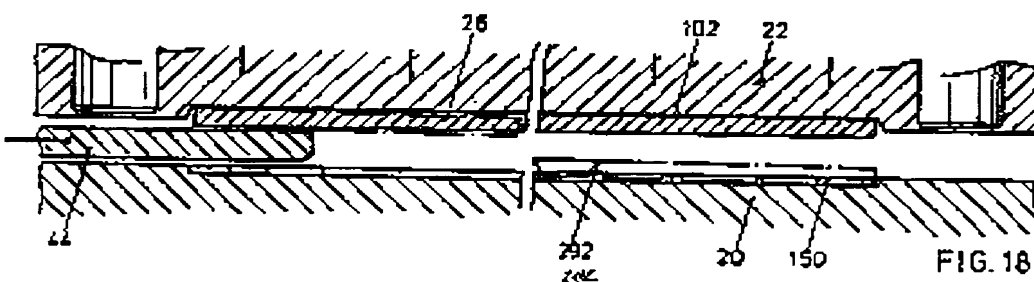

FIG. 18D

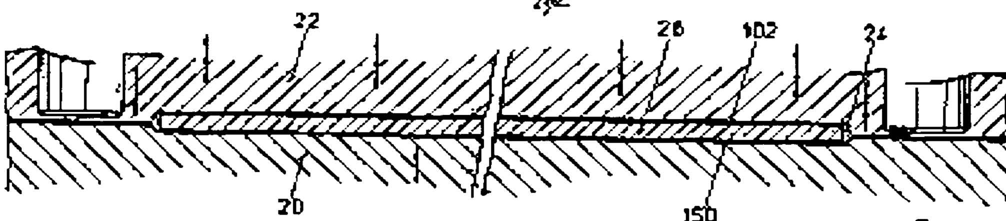

FIG. 18E

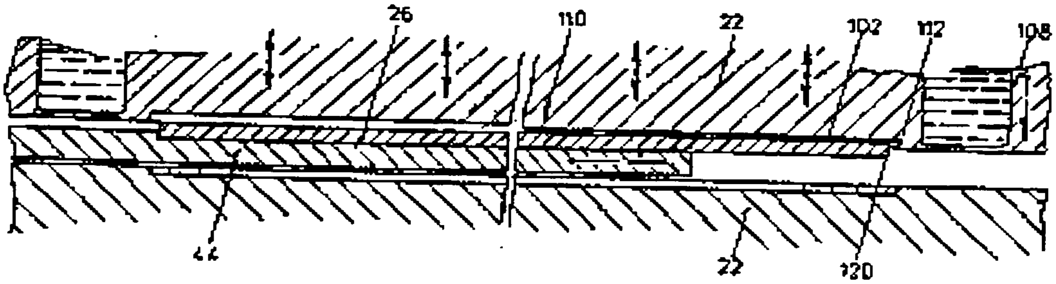

FIG. 19A

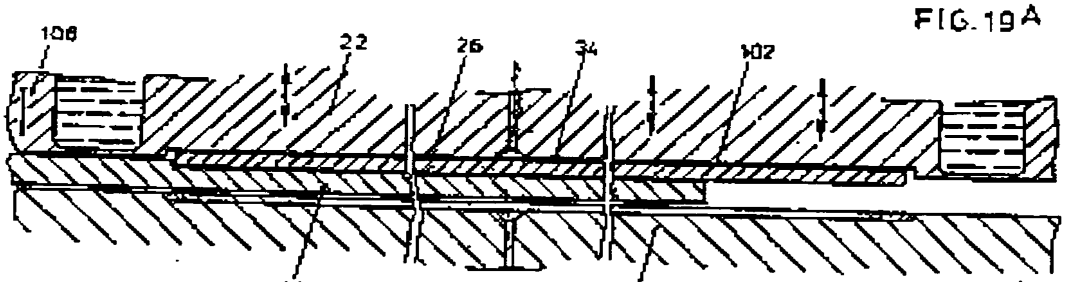

FIG. 19B

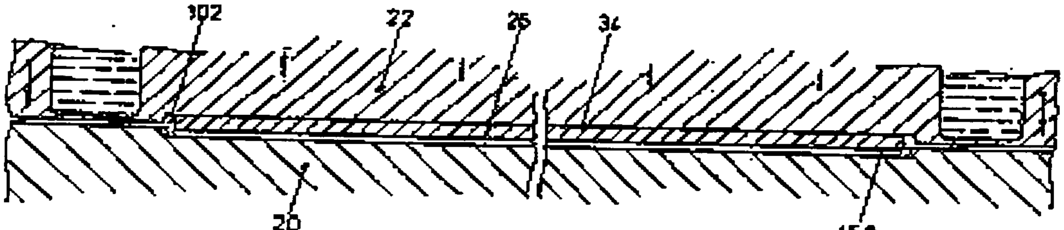

FIG. 19C

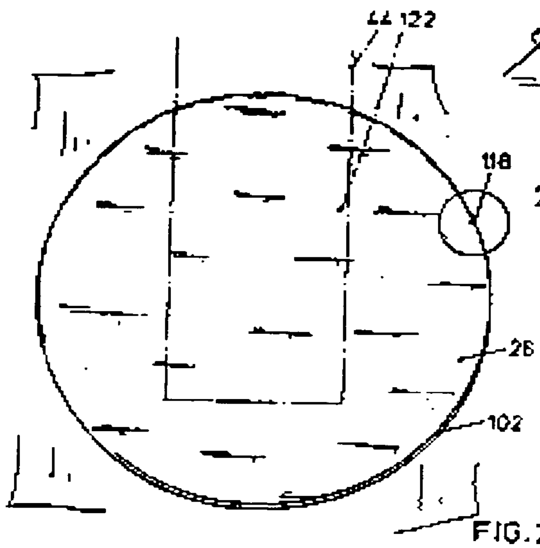

FIG. 20

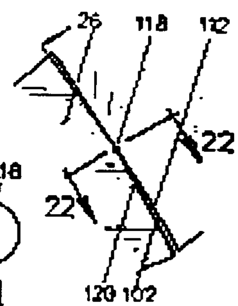

FIG. 21

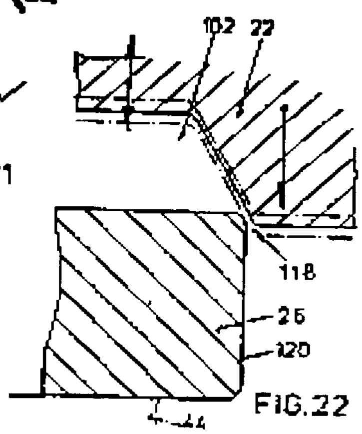

FIG. 22

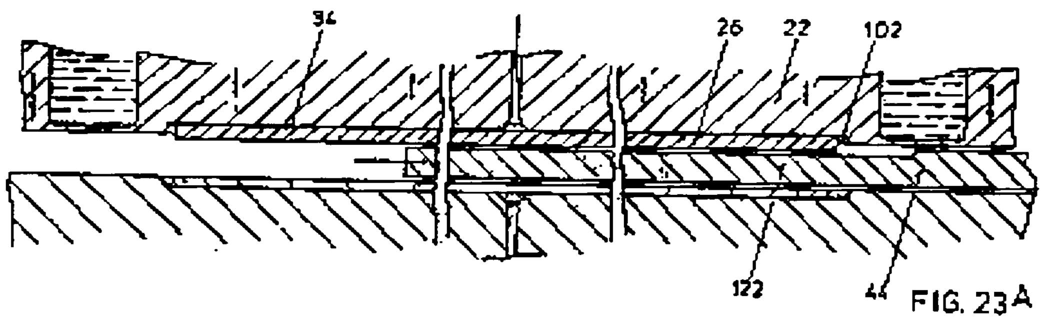

FIG. 23A

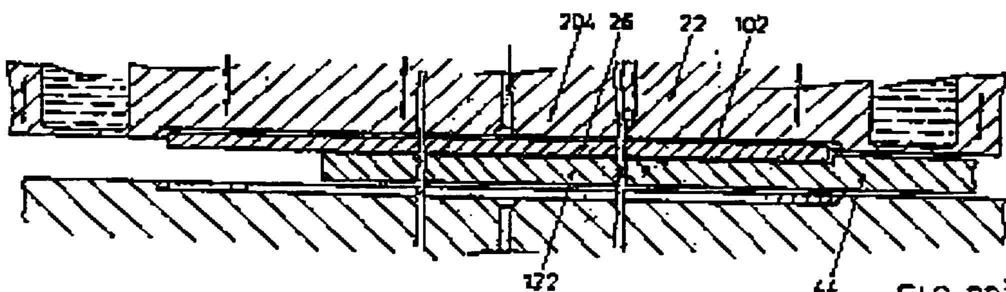

FIG. 23B

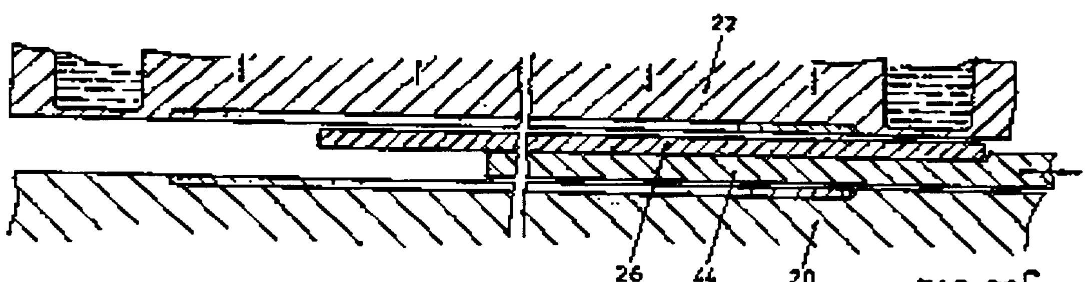

FIG. 23C

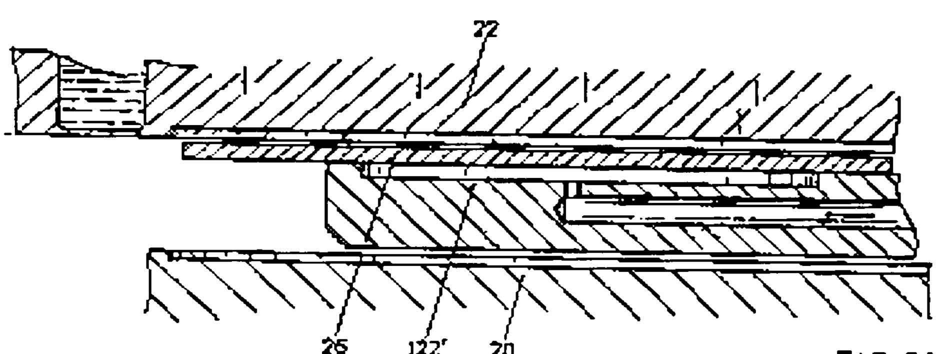

FIG. 23D

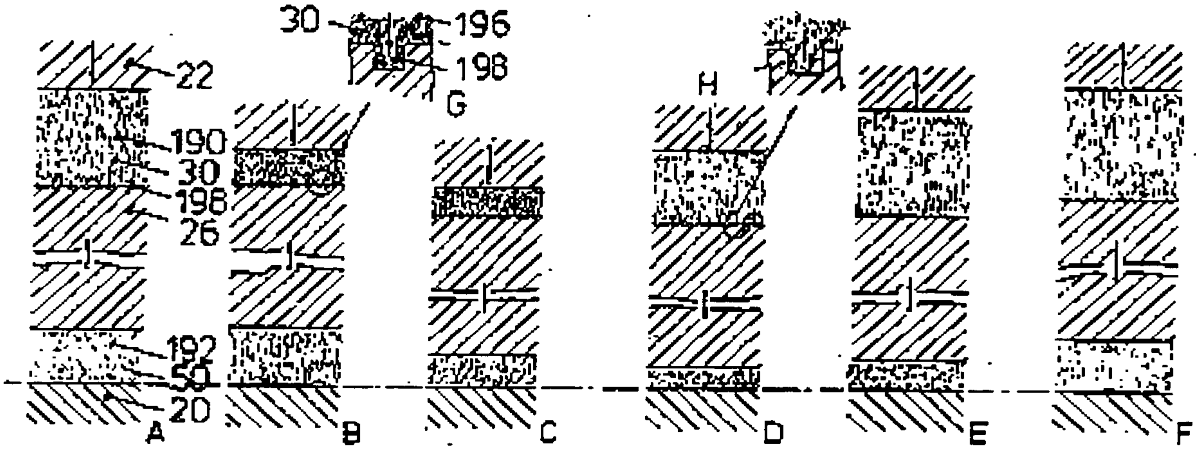

FIG. 25

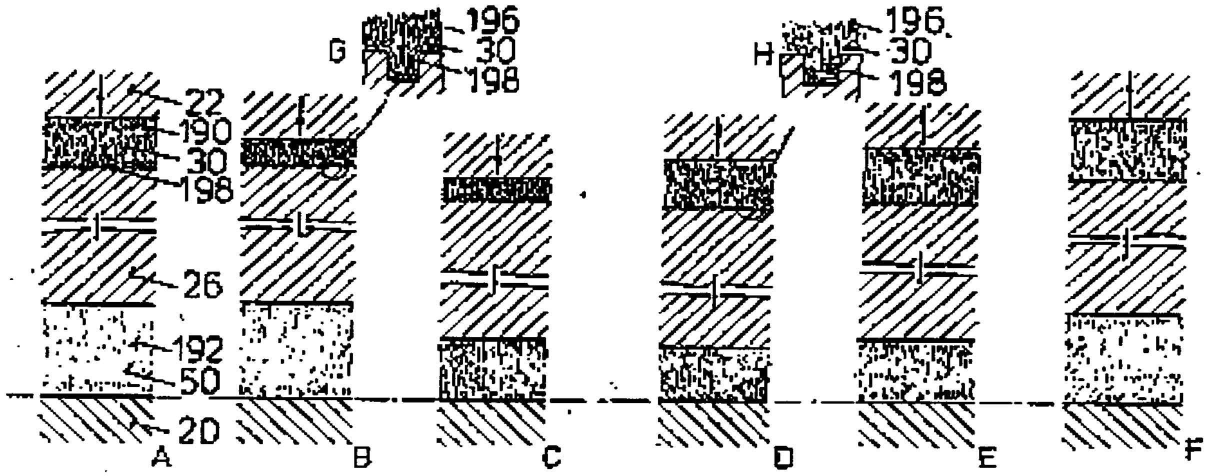

FIG. 24

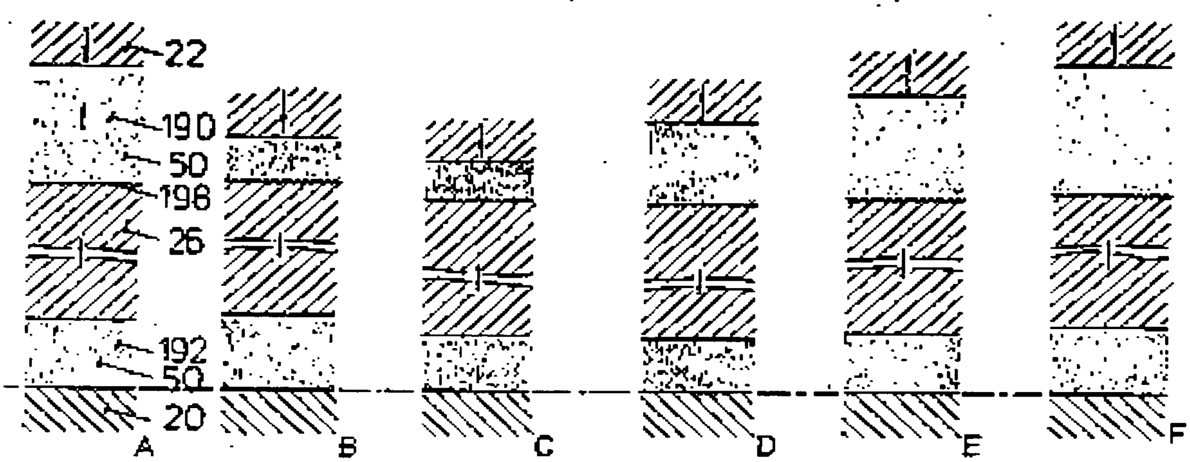

FIG. 26


22
190
30
198
26
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192
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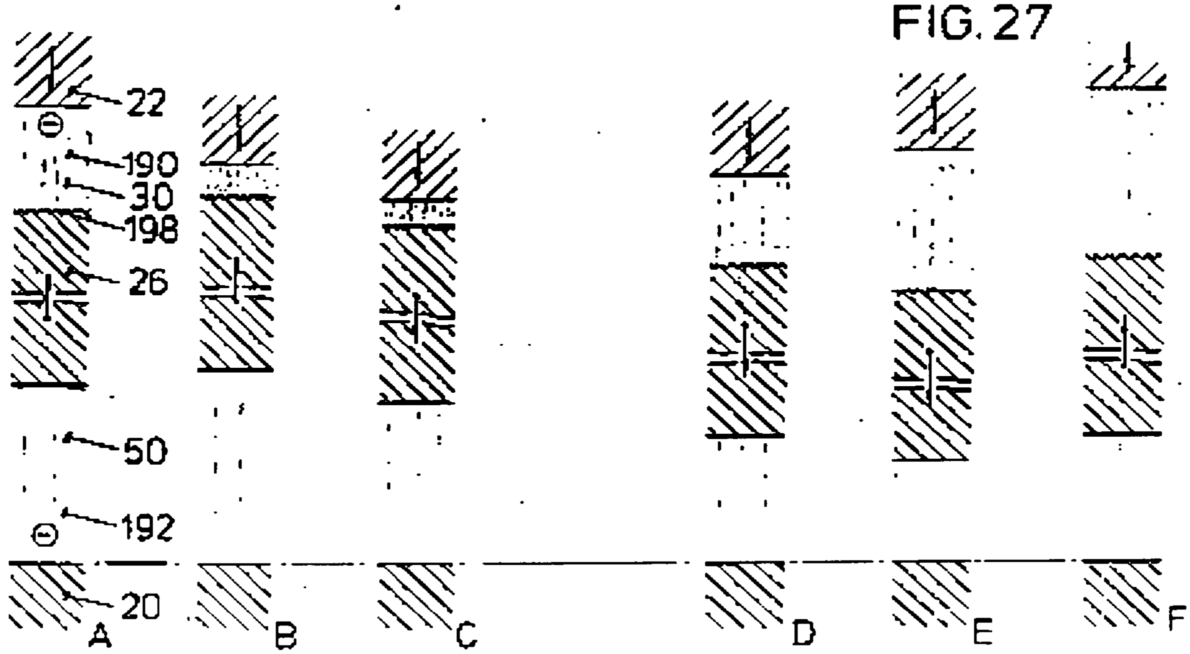
A
B
C
D
E
F

FIG. 27


22
190
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198
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192
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F

FIG. 28

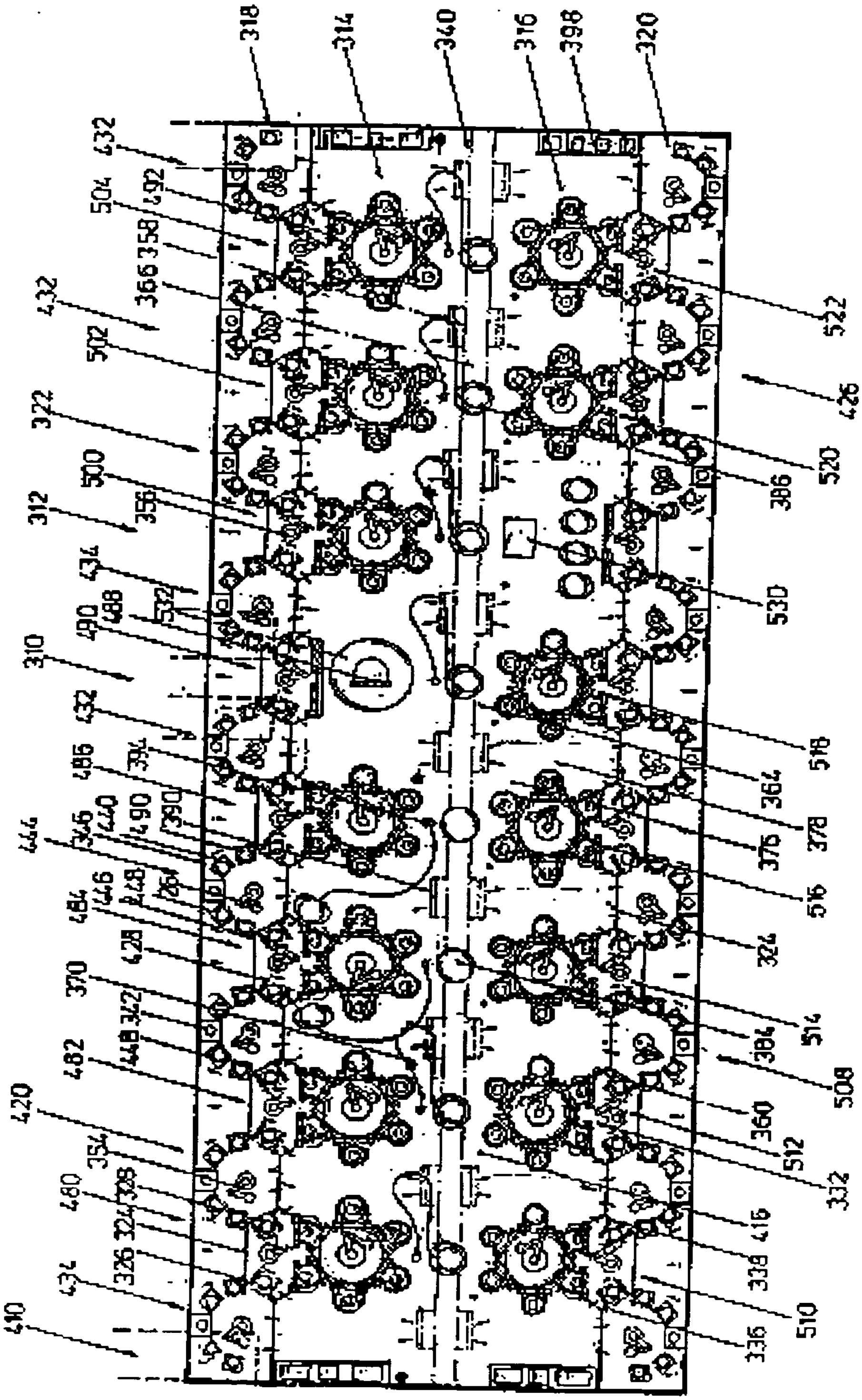

FIG.29

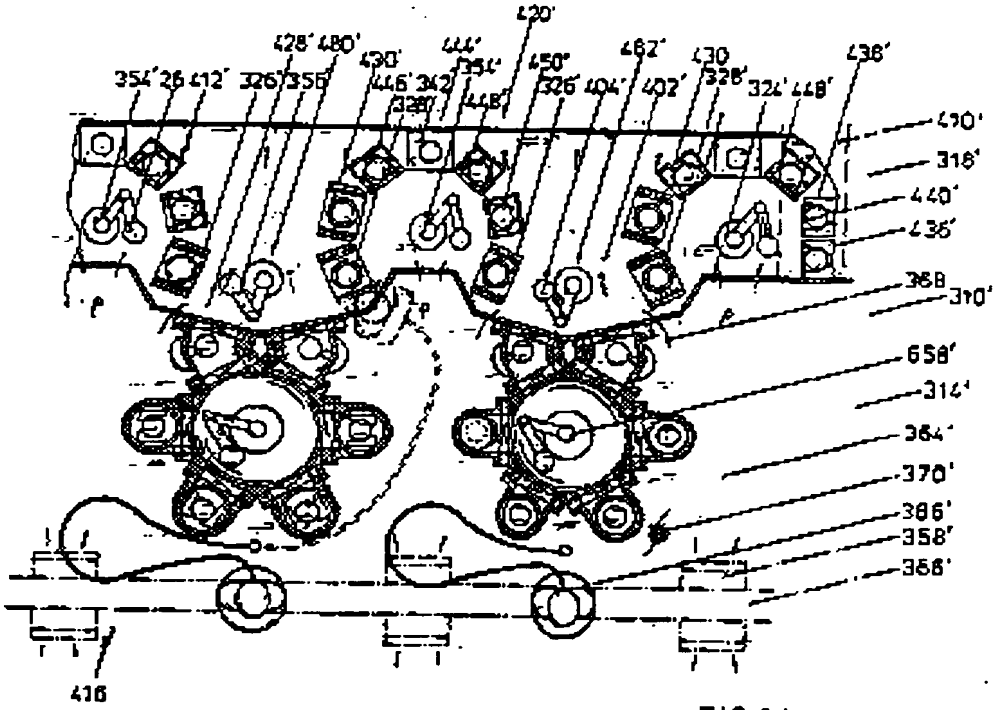

FIG. 30

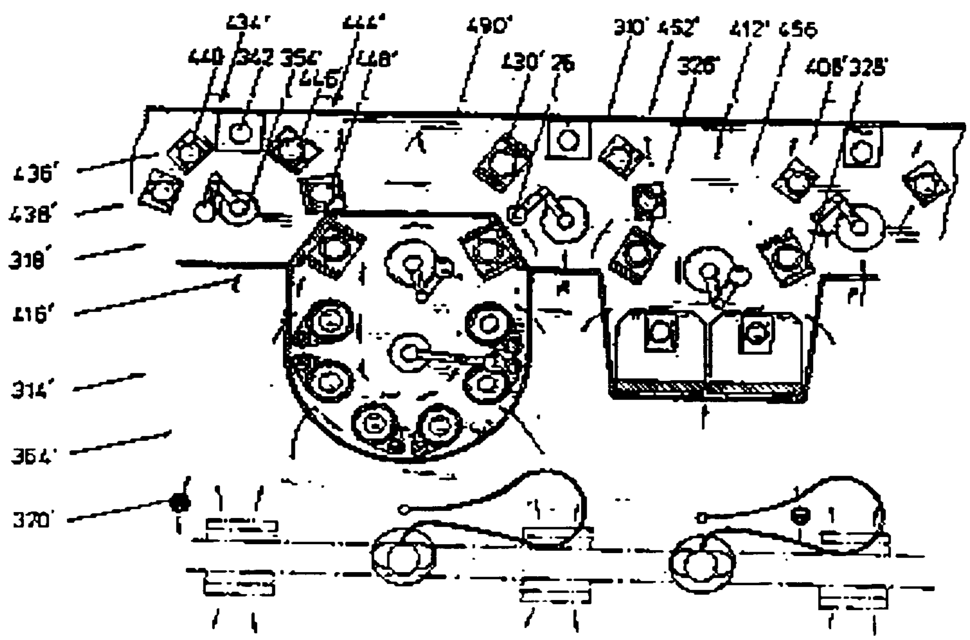

FIG. 31

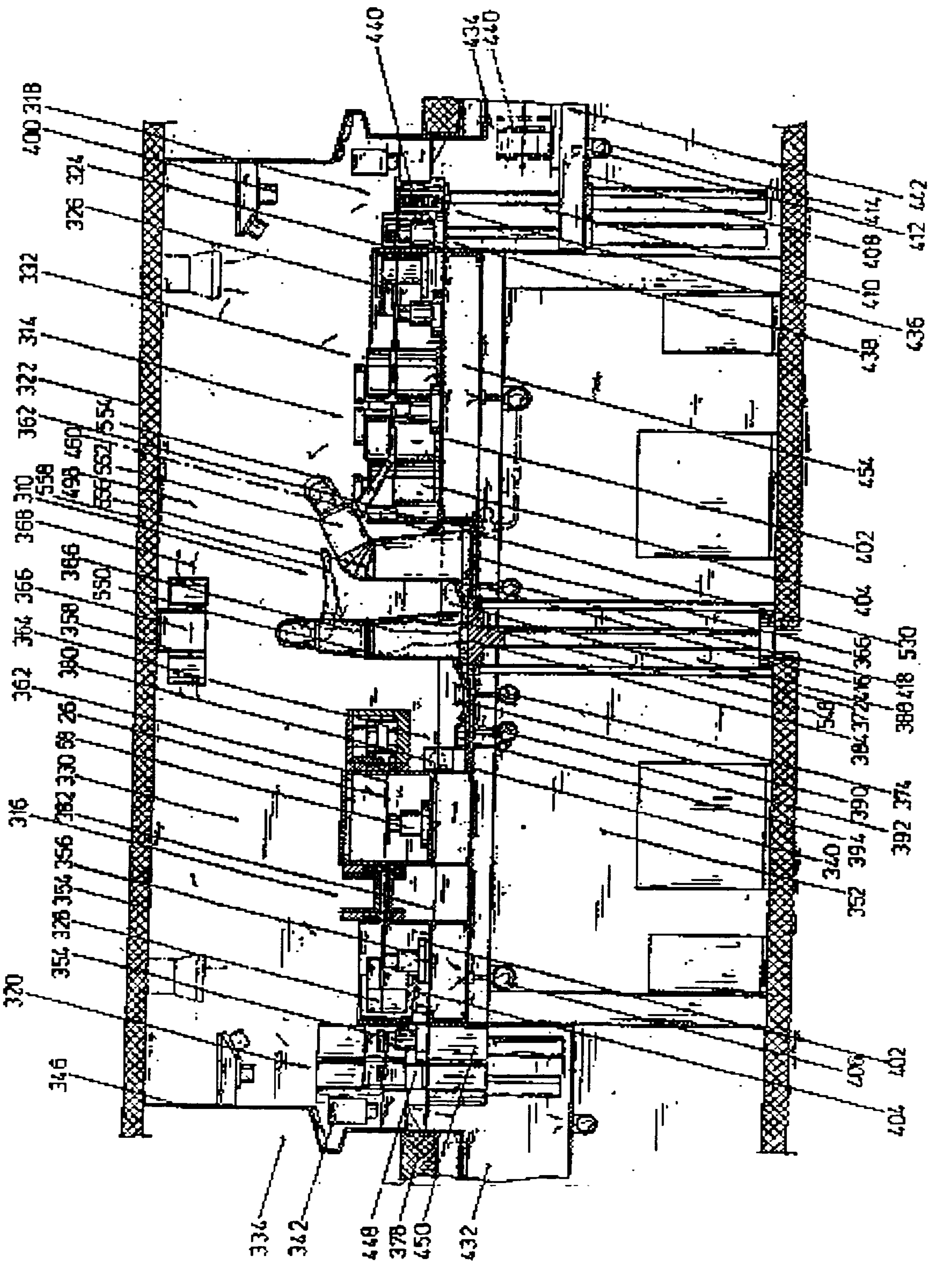

FIG.32

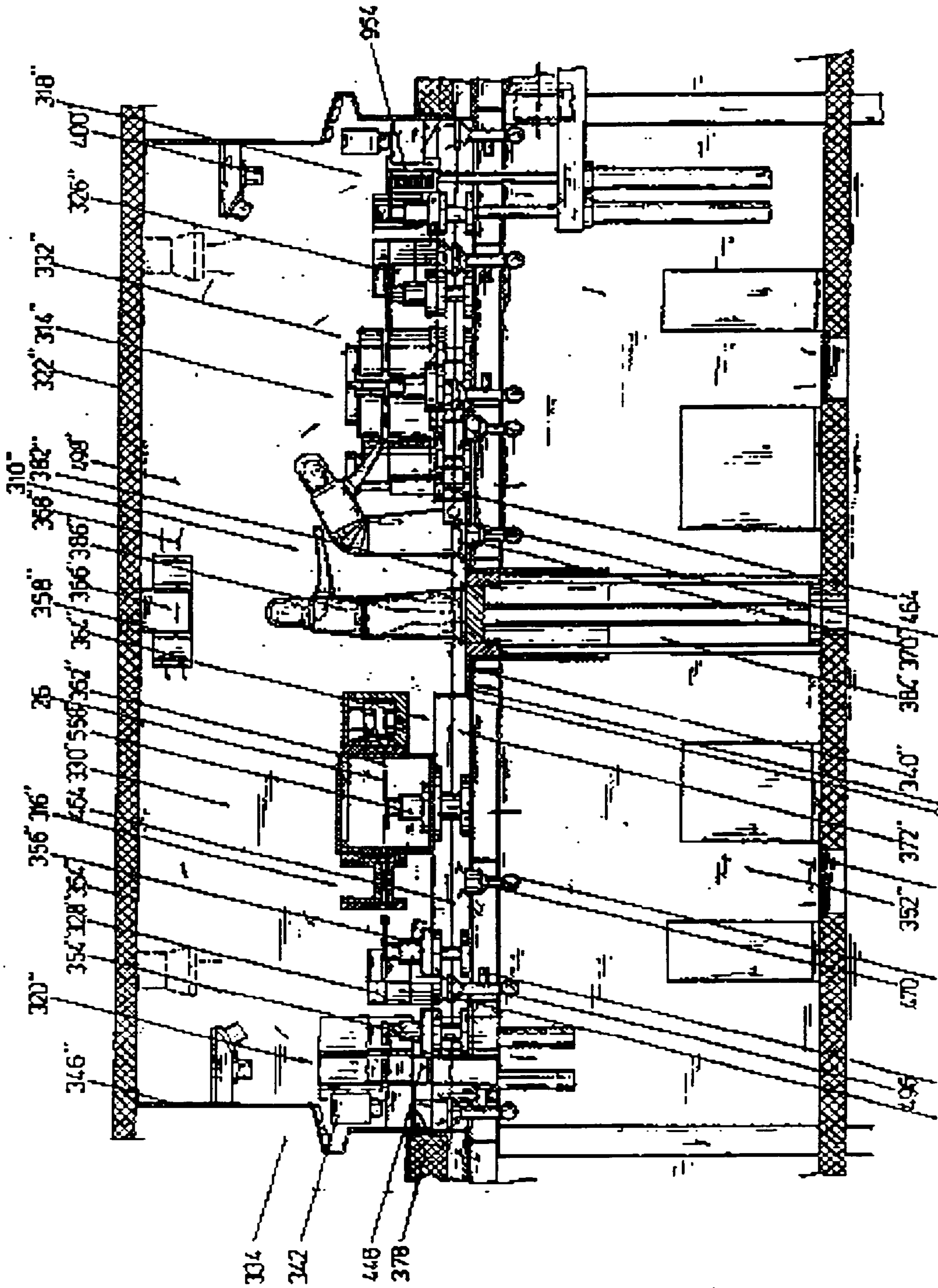

FIG.33